PROCEEDINGS OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

HELD AT PHILADELPHIA, FOR PROMOTING USEFUL KNOWLEDGE.

VOL. X. 1868. No. 80.

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PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

VOL. X. JULY, 1868. No. 80.

Stated Meeting, July 17th, 1868.

Present, five members.

Prof. J. C. CRESSON, Vice-President, in the Chair.

Donations for the Library were announced from the Paris Geographical Society; the Bureau des Longitudes; London Royal Astronomical Society; Boston Natural History Society; Bureau of the War Department; Congressional Library; Smithsonian Institute; San Francisco Library; the Franklin Institute; and the Editors of the Journal of Medical Sciences at Philadelphia.

The death of Edward Coles, a member of the Society, was announced, as having taken place on the 7th inst., in the 82d year of his age.

Professor Cope presented for publication a paper entitled: *A Synopsis of the extinct Batrachia and Reptilia of North America.* Referred to a Committee consisting of Dr. Leidy, Professor Trego and Dr. Ruschenberger.

Professor Cope read a communication: *On the Origin of Genera.* Referred to the Secretaries.

Mr. Chase, continuing his remarks made at the last meeting, adduced fresh evidence of a tidal rain-fall, from a discussion of Meteorological Observations made uninterruptedly for 43½ years at Philadelphia.

Dr. H. C. Wood presented for publication a paper *on Pha-*

langia and Pedipalpi collected by Prof. Orton in Western South America, with a description of a new African species. Referred to the same Committee.

Ballotting for members and other business was postponed, and the Society was adjourned.

Stated Meeting, August 21st, 1868.

Present, two members.

Dr. H. C. Wood, in the Chair.

Letters acknowledging the reception of Proceedings No. 76 were received from the Imperial Geographical Society of Russia, and the Royal Academy at Lisbon.

Letters announcing donations to the Library were read from the Imperial Russian Geological Society; M. Schyanoff of Kiew; and the Surgeon General's Office at Washington.

A photograph for the Album was received from Prof. Winchell of Ann Arbor, Michigan.

Donations for the Library were announced from Alexander Schyanoff of Kiew; the Danish Antiquarian Society; the Prussian Academy; the Academy d. Lincei; the Teyler Museum; French Geographical Society; Royal Asiatic Society; Essex Institute; Boston Natural History Society, Public Library, S. H. Scudder, M. D., and Lothrop and Kemp; the American Antiquarian Society; Yale College; Silliman's Journal; Academy of Natural Sciences; Franklin Institute; Medical News; Burnham and Bartlett of Chicago; the Academy of Sciences and Prof. G. S. Swallow of St. Louis.

The minutes of the last meeting of the Board of Officers and Council were read.

Pending nominations Nos. 589, 590, 591, 592 were read, and the Society was adjourned.

Stated Meeting, September 18th, 1868.

Present, twelve members.

JOHN C. CRESSON, Vice-President, in the Chair.

Letters announcing donations from the Library were read from the Geological Survey of Sweden, Dec. 31, 1867; the Belgian Academy, April 2, 1868; the Physical Society at Berlin, April 15, 1868; the Austrian Academy, April 23d, 1868; Boston Natural History Society, May 15, 1868; and the British Ordinance Survey Office, dated Southampton, Aug. 11, 1868.

Letters acknowledging receipt of publications were received from the Belgian Academy; Riga Natural History Union; Berlin Physical Society; and Boston Natural History Society.

Donations for the Library were announced from the Riga Natural History Union; Swedish Geological Survey; Dr. Koch; the Berlin Physical Society; German Geological Society; Bremen Natural History Union; Dr. F. C. Noll, curator of the Zoological Gardens; M. Joachim Barrande; Austrian Academy; and Dr. C. Scherzer of Vienna.

The Committee on Mr. Cope's paper, on Extinct Batrachia and Reptilia of North America, recommended its publication in the Transactions. The report, after consideration, was recommitted, for the paper to be completed.

The decease of the following members of the Society was reported by the Secretaries:—

Charles Adolph Morlot; Feb'y 10, 1867, ætat 46.

Gen. Geo. A. McCall; Feb'y, 1868.

M. Boucher de Perthes; Aug. 3, 1868, ætat 80.

A copy of the proceedings No. 78 (79) just published was laid on the table, by the Secretaries.

Pending nominations 589, 590, 591, 592 were read, and the Society was adjourned.

Stated Meeting, October 2, 1868.

Present, eleven members.

JUDGE SHARSWOOD, Vice-President, in the Chair.

A letter was received from Mr. Moncure Robinson forwarding a donation for the Library from M. Michel Chevalier. Other donations for the Library were received from Prof. Zantedeschi, the Prussian Academy, the Geological Society and Meteorological Society of London; Radcliffe Observatory; Franklin Institute; and Adjutant General's Office at Washington.

The decease of Dr. Francis West, in Philadelphia, on the 24th of September, in the 59th year of his age, was announced by Prof. Trego.

A communication was received from Prof. J. D. Whitney, Chief of the Geological Survey of California, entitled *Notes on the Origin of Bitumens, together with experiments upon the formation of Asphaltum. By S. F. Peckham.* On motion of Prof. Cresson it was referred to the Secretaries, to publish in whole or part, in the Proceedings.

A communication was received from Prof. F. V. Hayden, dated Fort Sanders, Wyoming Territory, Sept. 20th, 1868, entitled: *Notes on the Geology of Wyoming and Colorado Territories, No.* 1. *By F. V. Hayden.* On motion of Prof. Cresson, it was referred to the Secretary to publish, in whole or in part, in the Proceedings.

A communication was made by Mr. Chase of diagrams, curves of rainfall at Surrey England and at Philadelphia, between the years 1825 and 1864, and of his conclusions therefrom deduced as to the relations of their *maxima* and *minima* to the phases of the Moon.

The portrait of Dr. Franklin Bache, by Waugh, was exhibited for the inspection of members.

Nominations Nos. 589 to 592 were read, and the Society was adjourned.

Notes on the origin of Bitumens, together with experiments upon the formation of Asphaltum; by S. F. Peckham. Communicated by Prof. J. D. Whitney, Chief of the Geological Survey of California, for the Proceedings of the American Philosophical Society. Sep. 18, 1868.

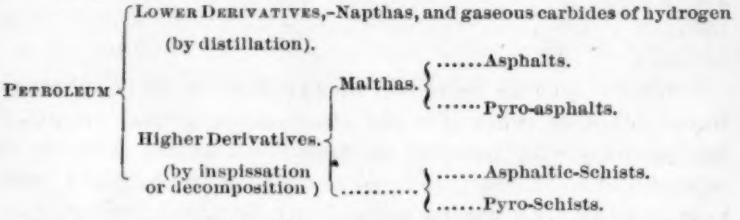
The lack of clear definitions of the specific differences existing between the different varieties of bitumen, or perhaps more strictly speaking, the lack of a uniform and exact nomenclature by which to designate those differences, has led to much confusion in description, and has rendered a comparison of the notes of different observers a task of much difficulty. It is for the purpose of suggesting a more exact nomenclature, as well as to point out the conformity or nonconformity, of the results of my own observations with existing theories, that the following notes are offered.

In all the more extended treatises upon chemistry and mineralogy, definitions are given in more or less detail of naphtha, petroleum, maltha and asphaltum, as varieties of bitumen. The generic relation of the different forms of bitumen and the difference between asphalt and the allied minerals guayaquillite, idrialine, etc.; also the marked differences existing between true solid bitumens and pyrobitumens, or substances yielding bitumen upon application of heat, has been very clearly pointed out by Dr. T. S. Hunt upon several occasions.* He makes fusibility, and solubility in bi-sulphide of carbon a distinguishing test of all true bitumens, and further shows that substances otherwise resembling bitumens which are not soluble in this menstruum are not coals but derivatives of bitumen.

It appears to me desirable that the generic term "Bitumen" should be so employed as to include *all* liquid or solid mineral hydrocarbons soluble in bi-sulphide of carbon, and minerals from which they may be derived which are not true coals; coals from which they may be derived being termed bituminous. Regarding therefore petroleum as the normal form of bitumen, the

* Chem. News, VI. 5, Am. Journal of Sci. and Arts, (2) XXXV. 157.

other varieties derived from it will be found susceptible of the following classification.



The exceptional forms before mentioned, do not perhaps admit of any classification in relation to petroleum, having been formed probably under peculiar circumstances, which were local in their action.

I shall assume, without asserting it to be a fact, that petroleum is the normal or primary product of the decomposition of marine animal or vegetable organisms, chiefly the former, and that nearly all other varieties of bitumen are products of a subsequent decomposition of petroleum, differing both in kind and degree.

Various opinions have been expressed concerning the origin of petroleum. Until quite recently, all of these theories were based upon the assumption that it has been derived from vegetable or animal organisms. It has been supposed to be the product of the decomposition of woody fibre by which more of the carbon and less of the hydrogen has been evolved than by the decomposition which has produced coal. Again, it has been supposed to be the product of the natural distillation of pyrobituminous shales and coals. M. Lesquereux attributes its origin to the partial decomposition of low forms of marine vegetation. Yet, again M. Berthelot has advanced the theory that by complex chemical changes at present taking place in the interior of the earth, petroleum is being continually set free. The following extract translated from his paper, will serve to give an idea of his views upon this subject.

"If in accordance with an hypothesis recently announced by M. Daubré, it be admitted that the terrestrial mass contains free alkali metals in its interior, this hypothesis alone, together with experiments that I have lately published, furnishes almost of necessity a method of explaining the formation of carbides of hydrogen. According to my experiments, when carbonic acid,

which everywhere infiltrates the terrestrial crust comes, in contact with the alkali metals at a high temperature, acetylides are formed. These same acetylides also result from contact of the earthy carbonates with the alkali metals even below a dull red heat.

"Now the alkaline acetylides thus produced could be subjected to the action of vapor of water; free acetyline would result, if the products were removed immediately from the influence of heat and of hydrogen (produced at the same time by the reaction of water upon the free metals) and the other bodies which are found present. But in consequence of the different conditions the acetyline would not exist, as has been proved by my recent experiments.

"In its place we obtain either the products of its condensation, which approach the bitumens and tars, or the products of the reaction of hydrogen upon those bodies already condensed. That is to say, more hydrogenated carbides. For example, hydrogen reacting upon the acetylene, engenders ethylene and hydride of ethylene. A new reaction of the hydrogen either upon the polymeres of acetylene or upon those of ethylene would engender formenic carbides, the same as those which constitute American petroleum. An almost unlimited diversity in the reaction is here possible, according to the temperature and the bodies present.

"We can thus imagine the production by a purely mineral method, of all the natural carbides. The intervention of heat, of water and the alkali metals, together with the tendency of the carbides to unite with each other to form matters more condensed, are sufficient to account for the formation of these curious compounds. Their formation could thus be effected in a continuous manner, because the reactions which give birth to them are continually renewed. * * *

"This hypothesis is susceptible of further development, but I prefer to dwell within the limits authorized by my experiments without wishing to announce other than geological possibilities."*

I am convinced that the remains of animal life have contributed much more largely to the formation of petroleum than has been generally supposed, and further that the different varieties

* Annales de Chemie. et de Physique, Dec., 1866.

of petroleum are largely due to the varied forms of animal life existing during the different geological epochs to which the rocks belong, from which the oil primarily issues. This latter idea was suggested by a remark of Dr. T. S. Hunt when he says: "their presence" (that is, the petroleums of Pennsylvania and Canada) "in the lower palæozoic rocks which contain no traces of land plants, shows that they have not in all cases been derived from terrestrial vegetation but may have been formed from marine plants or animals; the latter is not surprising when we consider that a considerable portion of the tissues of the lower marine animals is destitute of nitrogen and very similar in chemical constitution to the woody fibre of plants.*"

This opinion is further strengthened and confirmed when we find in rocks of tertiary age, in which fossil remains of the higher marine animals are found in abundance, a petroleum comparatively rich in nitrogen, of unstable constitution and undergoing decomposition in a manner similar to putrefaction. Such is the character of the petroleum issuing from the Miocene of the coast ranges of Southern California, and from such meagre accounts as are accessible, I infer that such are the characteristics of the petroleum of the Baku region on the shores of the Caspian Sea, issuing from rocks which I am assured by the Baron Koschkull are also of Miocene age.

Let us examine these different theories. Bischof has shown very clearly and with abundant illustrations, the manner in which the decompositions may be effected which produce the different kinds of coals and bitumens from wood.† These illustrations have been abridged and arranged in tabular form by Dr. Hunt, in a paper published in the sixth volume of the Chemical News.‡ The reactions necessary to produce petroleum instead of coal have been further traced by him in the article before quoted from the American Journal.§ The theoretical possibility of such a decomposition requires no further proof, but it should be observed that these theories are based upon the results of ultimate not proximate analysis.

If it be granted that a theoretical compound may be obtained from cellulose having an equal number of equivalents of carbon and hydrogen, the general formula for petroleum, the fact still remains that petroleum has never been observed under such

* Chem. News, VI. 5.
† Chem. and Phys. Geology, I. 274.
‡ Chem. News, VI. 33.
§ Am. Jour. Sci. and Arts, (2) XXXV. 158.

circumstances as to leave no possibility of a doubt that it was derived from wood. The observations of Mr. J. P. Lesley are the most conclusive of any that I have met, yet, it appears to me the facts as observed by him, may be accounted for upon an hypothesis more in harmony with those connected with the occurrence of mineral oils in other localities.* Several instances are cited by Bischof, in illustration of the fact that wood has changed to lignite during the historic period.† The discovery of the piles driven in the Thames by the ancient Britons, and of timber in long abandoned mines, both found in a carbonized condition, will serve as examples. Still more recent discoveries were made at Port Hudson, La., where wood bearing the marks of the axe was found in a sedimentary deposite of the Mississippi river in a carbonized or as the writer expresses it, bituminized condition.‡ It is therefore to be inferred that the formation of petroleum from woody fibre presupposes a peculiar decomposition, under conditions so extraordinary as not to exist at present; conditions too that though possible during former geological epochs were then by no means universal, as is proved by the fact that petroleum and coal alike occur in almost every formation from the primary to the tertiary, and often in close proximity to each other. The formation in Southern California in which petroleum and other forms of bitumen occur in vast quantities, contains lignitic remains at rare intervals, proving that the conditions essential to the formation of lignite and petroleum were present at the same time.

Again, coal is a compound body, while petroleum is a compound of compounds — a mixture of many substances of definite constitution. Substances identical with those existing in petroleum may be obtained from coal, but it is only upon the decomposition of the coal that they are obtained, while they exist in the petroleum already formed. These substances are also formed by the destructive distillation of wood with exclusion of oxygen, but they do not exist in the wood already formed, and are only formed artificially, by processes which are not analogous to any which we have a right to suppose have ever been active in *nature*. Animal matter may be subjected to such

* Pro. Am. Phil. Soc. X. 33 and 187. † Chem. and Phys. Geology, I. 294.

‡ Am. Jour. (1) XXXV. 345—XXXVI. 118. From the description it appears that the remains were lignitic rather than bituminous.

researches of Profs. Warren and Storer. They saponified Menhaden Oil with lime and then distilled the lime soap.* Upon rectifying the lighter portions of the crude distillate and subjecting it to the process of fractionation invented by Prof. Warren, they obtained the identical hydrocarbons found by them in Pennsylvania petroleum. Taken as a whole the distillate resembled more nearly Rangoon petroleum, which has been analyzed by the same gentleman.

The facts just mentioned when viewed by themselves, suggest the theory that petroleum is the product of the distillation of pyrobituminous minerals by natural processes. Excepting in the case of some of the lightest varieties, more properly termed naphthas, I do not consider that there is any further evidence to support such an hypothesis. The discovery of strata saturated with petroleum or the products of its decomposition, while those above and below do not contain a trace of it, is sufficient in itself to refute such an opinion.

The opinions entertained by M. Lesquereux when applied to petroleums issuing from palæozoic rocks, are perhaps as little open to objection as any theory of which I have spoken; but as a formula applicable to all conditions under which petroleum occurs, they cannot be maintained. Even when confined to the application which he has made of them, I think they claim too exclusively a vegetable origin. It would be equally open to objection to claim that those oils were without exception of animal origin. The differences between the animal and vegetable life of a deep sea fauna, both in functional and elementary organization, are too slight to admit of any nice theoretical distinctions being drawn respecting the products of their decomposition. A mass of polypi undergoing decomposition upon a beach would doubtless saturate the sand with carbonaceous matter as readily as an equal bulk of algæ. If petroleum were invariably derived from marine algæ, we should expect to find it identical in composition wherever found, as the conditions favorable to their growth and their composition are in all cases too nearly identical to admit of any marked variation in the products of their decomposition. We should not therefore expect to find in one formation a very stable substance, and in another treatment as to yield similar results, as has been shown by the

* Mem. Am. Acad. N. S. IX. 177.

one equally unstable, yet both derived from a source which has varied but slightly, if at all, through all geological epochs.

The theory of M. Berthelot appears to me to derive less support from observed facts than any which has been proposed. It was doubtless formed with reference to the petroleums of Pennsylvania, which are among the purest mineral hydrocarbons of any found in large quantities. The very small proportion of nitrogen existing in these oils, might perhaps be accounted for as an accidental constituent of the limestone, or as being mechanically mingled with the carbonic acid or watery vapor. Neither supposition is at all probable, since free nitrogen possesses such slight affinities. It adds nothing to its support to admit that the alkali metals do exist in the interior of the earth, in the free state. The very great difference observed between the varieties of petroleum, cannot be satisfactorily explained upon any hypothesis, that regards them as the results of the same process acting upon like materials; neither should it be expected that a process yielding an almost "unlimited diversity" of products under slightly varying circumstances, would furnish a uniform result over a very wide area. Samples of Pennsylvania petroleum of the same density, when gathered from widely separated localities, furnish identical results upon analysis; so too do California petroleums, though gathered from localities fifty miles apart, and yet the two varieties of oil are exceedingly unlike. "It is moreover altogether erroneous, to attempt to explain the causes of geological facts, by the aid of supposed analogies with the complex apparatus of physical cabinets, whose existence in nature could scarcely be conceived by the boldest and most unrestrained imagination."*

Too much has been assumed concerning the constitution of all petroleums from the researches of the few investigators who have studied Pennsylvania petroleum. Because Messrs. Warren and Storer discovered that the same proximate principles exist in that portion of Pennsylvania and Rangoon petroleums boiling at or below 200° C., yet not in the same relative proportion, and not without admixture of different substances, it must not be taken for granted that all petroleums contain those principles. Very little is at present known concerning the more dense portions of Pennsylvania petroleum having boiling points

* Bischof. Chem. and Phys. Geology, I. 243.

above 200° C., amounting to about thirty per cent. by measure. When this dense portion amounts in other petroleums to about seventy per cent., even should the lighter portions contain the same principles, the question of similarity between the two oils requires a comparison of the heavier quite as much as the lighter portions.

The small proportion of nitrogen found in the petroleums of the palæozoic rocks of Pennsylvania and Canada, might be derived from any source to which the origin of petroleum has yet been ascribed; but when we pass up from those early formations through the secondary rocks to the middle tertiary, to a deposit rich in remains of the higher marine animals, in which cetacean bones are as frequently met as any other fossil, and find an oil comparatively rich in nitrogen, we are forced to admit that the conditions of such theories are less in accordance with facts. The decomposition of carbonic acid and water by alkali metals would scarcely be expected to produce an hydrocarbon of very unstable character, containing so large a proportion of nitrogen as to render its decomposition analogous to putrefaction. Nor should we expect such results from the partial decomposition of vegetable matter, either of terrestrial or marine origin. The small proportion of nitrogenous matter in the woody structure of forest trees, and the still smaller proportion in marine vegetation would fail to furnish the requisite amount, but in the partial decomposition of the remains of highly organized animal tissue, we have an abundant source of nitrogen.

Dr. Hunt has shown the possible derivation of compounds having an equal number of equivalents of carbon and hydrogen, similar to or identical with petroleum, from the decomposition of animal tissue. He discusses this possibility however, only with reference to the bitumens "met with in the lower Silurian and Devonian limestones of marine origin."*

It is not difficult to propose a theoretical decomposition of many of the proximate principles of animal origin, which would yield a substance having an equal number of equivalents of carbon and hydrogen. Thus, if six equivalents of carbonic acid be removed from one equivalent of stearic acid, an equal number of equivalents of carbon and hydrogen remain. One equivalent each of stearate and oleate of glycerine, when deprived of sixteen equivalents of carbonic acid and four of water, yield two

* Am Jour. Sci. and Arts, (2) XXX. 162.

hundred and twenty-four equivalents each of carbon and hydrogen.

The protein compounds of which animal tissues are composed contain carbon and hydrogen in nearly equal proportions and largely in excess of either of the other constituents. It would be difficult to devise any method by which they could undergo decomposition, with exclusion of oxygen, without producing an hydrocarbon or a variety of such bodies, and it is highly probable that they would contain nitrogen. When a mass of animal matter, consisting not only of the muscular tissue but of all the non-nitrogenous substances entering into animal organisms, was thus subjected to decomposition submerged in water, the product could not fail to be a nitro-hydrocarbon, which upon exposure to atmospheric oxygen would undergo a second decomposition into a greater or less number of the following named products, carbon, hydrocarbons, ammonia or free nitrogen, carbonic acid and water. The petroleums of Southern California, issuing primarily from Miocene shales, are of precisely this unstable character.

Although we have not that direct evidence of the formation of *all* petroleum from animal remains, that the carbonization of wood during the historic period and its cellular structure furnishes of the derivation of coal, we are not without positive proof that such a decomposition is possible through the agency of natural causes. Solid bitumen has been repeatedly found filling the cavities in the Lias of England, once filled with the gigantic marine lizards of that formation. "In some cases," says Dr. Hunt, "petroleum is found filling cavities in silurian limestones, as at Riviére de la Rose (Montmorenci) where it flows in drops from a fossil coral of the birds-eye limestone; and at Pakenham where it fills the cavities of the large orthoceratites in the Trenton.*" In one locality in California, a shaft was sunk upon an oil spring in the belt of oil shales. A reliable witness informed me that the excavation passed for several feet through a mass of fossil bones which were saturated with oil. The mass when thrown out retained the cellular structure of bone for several days, but finally crumbled on exposure to the atmosphere.

It may be urged that if petroleum was of animal origin it

* Chem. News, VI. 15. Am. Jour. (2) XXXV. 166. A very large number of similar instances are mentioned by Dr. Hunt and Dr. J. S. Newbury, as occurring in the United States and Canada.

would contain both phosphorous and sulphur. Phosphate of lime is quite freely soluble in water saturated with carbonic acid; and sulphuretted hydrogen is soluble in cold water excepting when it contains a free acid. Bones too are soluble in water containing either carbonic acid or chloride of sodium or ammonium.* Since water almost invariably contains carbonic acid, these products of decomposition would soon be borne away. Sulphates, especially those of the alkalies, when in solution, are decomposed when the water containing them flows through strata impregnated with organic matter, into sulphuretted hydrogen and a carbonate of the oxide present. When sulphuretted hydrogen infiltrates strata containing carbonate of lime, gypsum is formed and sulphur deposited.† Nearly every spring of bitumen in Southern California yields also more or less water, containing organic matter in solution, together with salts of soda, chiefly sulphate, carbonate and chloride. The water is also almost without exception, highly charged with sulphuretted hydrogen, and deposits of sulphur of considerable extent are of frequent occurrence, often accompanied with gypsum in irregular masses. As sulphur is sparingly soluble in petroleum, those of that region all contain it in small proportion. Should the water which accompanies the oil in Pennsylvania, be found to be free from sulphates, especially those of the alkalies, the fact would furnish an explanation of the remarkable freedom of those oils from sulphur. In the few instances in which oil containing sulphur has been found in cavities of fossils hermetically sealed, the sulphur might have been derived from the animal remains from which the oil originated.‡

In accordance with the foregoing conclusions, I repeat, let it be assumed that petroleum is the normal or primary product of the decomposition of organic matter, chiefly animal, then the different varieties are found to fall into two groups. The first group forms asphaltum by inspissation, if at all; it contains paraffine, and the products of the distillation of all the forms of bitumen derived from it, yield paraffine. This group I shall designate the class *A*, and it may be represented by the petroleums of the Oil Creek region, Pennsylvania. The second group forms

* Bischof Chem. and Phys. Geology, II. 28. † Ibid. I. 15 and 340.

‡ It would be of interest to know if any instances occur in which the limestone surrounding these cavities has been replaced by gypsum.

asphaltum by decomposition, it does not contain paraffine, neither do the distillates from any of its derivatives; this group I shall call the class *B*, and it may be represented by the petroleums of Southern California. The derived forms of these different classes are designated, asphalts of the class *A*, pyro-asphalts of the class *B*, etc.

The word naphtha is used to designate the most volatile products of the distillation of wood, coal or petroleum. When restricted in its use to this class of substances, it indicates an extremely volatile product of distillation, composed of carbon and hydrogen. The loose manner in which this term has been applied to products of exceedingly unlike character, has led to much confusion in description. I propose in this connection to limit its use to those extremely volatile and slightly colored mineral oils, which are occasionally met with in different localities, and which are evidently the product of a distillation carried on by natural processes.*

Gaseous carbides of hydrogen almost invariably accompany deposits of bitumen of every variety.

Maltha or mineral tar is, as its name implies, more nearly allied to tar in its physical properties than to oil. It is usually described as distinguished from petroleum by its viscidity, but a more marked dissimilarity is found in the manner in which the two are separated from mechanical admixture with either gaseous or liquid impurities. When petroleum is mingled with either water or air, they readily separate, as soon as the mixture is allowed to remain at rest, leaving the petroleum in a state of purity. With the more dense varieties this separation may be assisted by the aid of a gentle heat. Petroleum which has been thus separated from these impurities may be heated to its boiling point, when gentle ebullition ensues. If however an attempt is made to boil petroleum before such separation is complete, the water will subside as the temperature is raised, until at 100° C, the ebullition will become explosive from the escape of intermittent puffs of steam.

Crude maltha which has escaped from a fissure in a rock, or has been pumped from a well accompanied by water, in falling into a tank, entangles air in its descent. Many of the larger bubbles of both air and water readily separate, but the separa-

* See Humbolt's Travels, I. 198; III. 113, Bohn's Ed.

tion will not be complete if the maltha should remain at rest for months. When placed in tanks and moderately heated for a long time the separation is still incomplete. As the temperature is raised the liquid commences to foam, the foam finally occupying many times the bulk of the maltha. A sample of California maltha which I examined, appeared to be a pure black viscous bitumen of uniform consistence. When heated it began to foam perceptibly when the temperature was raised only ten degrees Fahr., and at 100° it foamed so rapidly that retort and worm were soon entirely filled. When heated in an open vessel the foam occupied about twenty times the bulk of the maltha, and the air and water were not expelled until the temperature had reached 230° Fahr.

The surface oils or tars obtained from the so-called surface wells, bored in the superficial detritus at Enniskillen, were malthas possessing this characteristic of viscidity, and presenting the same obstacles to successful distillation encountered in those from California.

The same causes which produce the lighter varieties of maltha from petroleum, whether it belong to the class *A* or *B*, if their action be continued, will cause the bitumen to become more and more dense, until it attains the consistency of pitch and finally hardens into solid asphaltum. The line of separation between maltha and asphaltum is wholly arbitrary.

Of the solid bituminous minerals which are derived from petroleum, there are four distinct species, viz: asphaltum, pyroasphaltum, asphaltic schists and pyroschists. The first two are pure bitumens, amorphous, with a brilliant conchoidal, sometimes angular, fracture. Asphaltum is soluble in bi-sulphide of carbon, pyroasphaltum is insoluble, but both yield a distillate soluble in that menstruum. Asphaltic schists and pyroschists are produced either by the saturation of pervious strata with petroleum, or by the admixture of organic and earthy matter during the deposition of sedimentrary strata, and their subsequent transformation into asphaltum. Under these two species may be included as varieties, all those bituminous minerals in which the earthy matter preponderates, whether it be sand, slate or limestone. They may be distinguished from each other by the same tests which serve to discriminate between asphalts and pyroasphalts. The pyroasphalts and schists are derived from the

asphaltic minerals by a change which renders them less soluble and fusible, and more nearly resembling coals.

The derivation of solid forms of bitumen from the class *A*, presupposes the possibility of forming asphaltum by the *inspissation* of petroleum. There are many small deposits filling cavities in rocks, both of asphalts and pyroasphalts, mentioned by Dr. Hunt and others, which *may* have been formed in this manner.* I am however extremely doubtful if the veins of so-called inspissated petroleum, of which albertite is an example, are not more probably the product of the distillation of asphaltic or pyroasphaltic schists, at a very low temperature, resulting from their metamorphosis. This view obtains additional force, if the theory be admitted that metamorphic action has taken place through the agency of watery vapor, as the distillation would then have taken place at the lowest temperature, under conditions favorable to the production of the largest quantity of distillate, of the greatest density possible. The enormous quantity of petroleum of ordinary density, which would upon inspissation furnish a solid residue, sufficient to form a deposit equal in extent to that of the albertite, can scarcely be conceived of even when compared with such vast accumulations as those of Pennsylvania and Rangoon.

Enormous deposits of asphaltum have been formed in California by the decomposition of petroleums of the class *B*. Asphaltic schists of the same class are also numerous in that region.

The classification of bitumens which I have adopted, was suggested by the results of many months' study of the formation of asphaltum in California, by natural causes, and by the results of analysis and experiments upon California and Pennsylvania petroleums, made in the laboratory of Brown University.

Throughout the oil-belt of Southern California, every form of bitumen derived from petroleum of the class *B*, is found, with the exception of naphtha, pyroasphalts and pyroschists. Light petroleums of a beautiful green color, pass through every degree of blackness and density to solid asphaltum. None of the natural forms, nor distillates produced from them, contain a trace of paraffine. The green oils upon exposure to atmos-

* Rep. Geo. Sur. of Canada, 1866, pp. 252 and 262; Vanuxem Rep. Geo. Sur. of New York.

pheric action soon become brown or black, but the increase in density is very gradual. These changes are not all produced upon the surface, as many of the springs yield maltha of varying density, and wells bored to a depth of from fifty to four hundred feet, have yielded bitumen which had undergone a greater or less change. A careful study of the different exposures over a very wide area, when taken in connection with the above mentioned facts, convinced me that such changes could not possibly be produced by inspissation, even in the warm climate of Southern California. I soon became equally well satisfied that they were due entirely to the action of atmospheric air, conveyed through the agency of rain water. Wherever the belt of shales from which the oil primarily issues is exposed in a nearly or quite perpendicular bluff, in which the shales are overlaid with impervious strata of sandstone or by several hundred feet of shales, the oil reaches the surface unchanged; but when the out crop occurs near the base of a gentle slope, or near the summit of the hills, in situations where the oil shales are horizontally exposed to the action of meteoric water over areas of considerable extent, the bitumen exudes of a density increased in proportion to the amount of exposure to which it has been subjected. The subterranean reservoirs of Pennsylvanian petroleum are overlaid by slightly disturbed and inclined strata of impervious sandstones, while the oil shales of California contain few large fissures but innumerable small ones, the fluid being held in them by capillary attraction and between the layers of shale, consequently exposing a very large surface of oil to contact with water, wherever the strata are so exposed as to admit of its infiltration. The strata in that region are very much broken and inclined at very high angles.

I became convinced at a very early date in my study of this subject that the difference in exposure alone, would perhaps account for the difference in the average density of the Pennsylvania and California oils, but the discovery of the fact that the latter did not contain paraffine, and that it was not found in oils distilled from them, led me to question the identity of these oils in chemical constitution.

The researches of Prof. Warren upon volatile hydrocarbons from various sources have shown conclusively, that ultimate analyses of crude petroleums are of little or no assistance in

making comparisons between them. I have not yet been able to devote the length of time required to make a complete separation of the proximate principles contained in the California Oils, but have accomplished enough to strengthen my first impression, that they are unlike those of corresponding density found in Pennsylvania Oils.

Having observed upon several occasions, small pools of California maltha which were literally filled with the larvæ of insects, I was led to believe that those oils contained an unusually large proportion of nitrogen. I therefore embraced the first opportunity offered, to make analyses of several samples and compare the results with that of an analysis of Pennsylvania Oil.*

The samples of California Oil had been gathered about nine months previous, that of Pennsylvania Oil I should think had been gathered about five months.

The results were as follows:

1 Sample		1.140 1.070	mean	1.105 per cent.
2 "		1.026 1.007	"	1.0165 "
3 "		1.088 1.083	"	1.0855 "
4 "	Maltha	.545 .584	"	.5645 "
	Pennsylvania Oil	mean of three analyses		.1912 "

The first sample was more dense than the second, but had been least exposed to atmospheric action. These results led me to infer, that the change consisted in the breaking up of unstable nitrogenous compounds, with deposition of uncombined carbon and consequent thickening and blackening of the oil.

One year later, wishing to test apparatus and materials for the further prosecution of this research, I made a trial analysis of the first sample, and was surprised to find that the quantity of nitrogen had diminished by more than one half. The analysis was repeated with the following results:

.493
.485
.486 mean .48775 per cent.
.487

* Mr. Moss, Supt. of an Oil Estate near San Buena Ventura, stated to me that oils fresh from tunnels, when exposed for a few days in a shallow dish, became filled with maggots.

The other samples furnished similar results. A portion of the first sample added to a portion of chemically pure Urea, gave the estimated quantity of nitrogen within a few thousandths of one per cent. A sample of Mecca Oil furnished me by Dr. J. S. Newbury, yielded .230 per cent., and another from the Cumberland Well, W. Va., furnished me by Prof. E. B. Andrews, yielded .054 per cent. The California Oils had been kept during the year in partially filled tin oil cans, closed with a cork. The loss of nitrogen was not accompanied by a corresponding increase in density, but the color had changed from dark brown to black. These results proved the change to be only in very small part due, to the breaking up of nitrogenous compounds.

I then determined to study the action of powerful oxidizing agents upon the two varieties of oil. For this purpose I first attempted to generate ozone by phosphorous, but found it very difficult to manage. I then had recourse to the action of concentrated sulphuric acid upon dry per-manganate of potash, as a source of ozone. With these reagents I was entirely successful. The first per-manganate that I used, contained a portion of undecomposed chlorate, and consequently gave off chlorine as well as ozone. Twenty-five grams each of the California and Pennsylvania Oils were subjected to the action of the mixed gases under identical conditions. The gases passed through the California Oils in small bubbles, each bubble being covered with a film of oil, which rising and adhering to each other filled the vessel, until a sudden collapse made room for more. With the Pennsylvania Oil the bubbles rose to the surface and burst. The quantity of both oils diminished in weight as the action was prolonged from two to fifteen days, but not in proportion to the length of time, as the amount of gases generated were greater for the time during the shorter than the longer period. No change whatever was perceptible in the Pennsylvania Oil excepting an increase in specific gravity. It remained perfectly fluid, retaining its color and partial transparency, and no sediment was deposited from it. With the California Oils on the contrary the action of the gases was extremely energetic. As the first portions passed through the oil and collapsed, minute particles of solid bitumen were left as the residuum of each bubble. As the action was prolonged the specific gravity of the

oil was increased, and solid bitumen in proportionally large amount was precipitated to the bottom of the vessel. After decanting the liquid portion from the solid, the latter was found to be a brittle asphalt, having a brilliant fracture, readily soluble in bi-sulphide of carbon and fusible at the boiling point of water. The minute particles first deposited were insoluble in that menstruum and infusible at the temperature before mentioned.

I next subjected other portions of the same samples to the action of ozone, prepared from pure and dry per-manganate of potash. The action of this gas was less energetic than when it was mixed with chlorine. No solid bitumen was formed insoluble in bi-sulphide of carbon, but in other respects its action upon each of the oils was not to be distinguished from that of the mixed gases. A third series of experiments were made by passing atmospheric air through portions of the same samples. The time was prolonged to fifty days, yet as in the former experiments with chlorine and ozone, the Pennsylvania Oil presented no change, which might not be attributed to very slow evaporation, retaining entirely its peculiarities of color, being changed only in consistence, which became as honey, and losing at least three-fourths of its bulk and weight.* No solid bitumen was deposited from the California Oil in this experiment. It diminished somewhat in bulk and weight, but increased in specific gravity in much greater proportion to its loss, than the Pennsylvania Oil.

An experiment made to ascertain the products of the decomposition, effected by the ozone upon the California Oil, failed to detect water, but exhibited carbonic acid in abundance, undoubtedly accompanied by gaseous carbides of hydrogen, although of the latter supposition I have as yet no positive proof.

It would be useless at present to attempt to form even a speculative explanation of the reactions which take place in the decomposition which forms asphaltum, as nothing is as yet known of the proximate principles which make up California petroleum.

These results of observation and experiment, simple as they may at first appear, are nevertheless the first steps towards a

* May not "Ozocerite" and other semi-transparent and elastic solid bitumens, be formed by the very gradual evaporation of petroleums resembling those of Pennsylvania?

correct and successful study of the dense liquid and the solid forms of bitumen. Ultimate analysis fails to throw any light upon the true character of a solid bitumen. It may detect traces of nitrogen, sulphur or oxygen, but fails to show whether they are essential or accidental elements — whether they belong to asphaltum or whether they are derived from organic impurities, with which every surface asphalt is contaminated. Methods of analysis requiring a high temperature are especially unsatisfactory, because it is impossible to discriminate in the results obtained between products of decomposition and those of composition. By perfecting and extending the application of this process to a large number of liquid bitumens of known constitution, and studying the results of their decomposition, both solid and gaseous, a method which in relation to asphaltum may in one sense be termed synthetic, the answer to this most interesting question of the origin of bitumens, may in some degree at least be removed from the domain of pure speculation to that of positive knowledge.

More extended research may lead to a modification of the views herein expressed. It appears to me not unlikely that petroleums exist intermediate between the classes *A* and *B*, which contain proximate principles found in each of them, and which, while they contain the paraffine series, may be susceptible of experiencing the asphaltic change. It may also appear probable that the more stable class *A* are entirely of vegetable origin, while the class *B* is of animal origin; a third and intermediate class, should it be found to exist, being derived in part from both sources. It is my intention to continue this reseach, not only in order to obtain more exact results respecting those oils already examined, but to extend its application to other petroleums. My object at present will be accomplished, if I call the attention of those engaged in the study of petroleums, to the consideration of these questions, the importance of which to science and technology, circumstances have strongly impressed upon my own mind.

Providence, R. I., *July 28th*, 1868.

NOTES ON THE GEOLOGY OF WYOMING AND COLORADO TERRITORIES.—No. 1.

By F. V. Hayden.

The following notes on the Geology of Wyoming Territory, along the line of the Union Pacific Rail Road, were prepared in the field after the labors of the day were completed, but the region examined presents so many features new to geologists, that I desire to have them published in the Proceedings of the American Philosophical Society in advance of my more elaborate report. The great interest which is investing all this region, will cause any remarks on the geological structure to be read with satisfaction.

My examinations properly begin at Cheyenne City, along the line of the Union Pacific Rail Road, but the connection of the geology eastward, with that of the west, will be better understood by a resumé of the structure of the country from Omaha. At Omaha, and extending above that point along the Missouri River for about forty miles, we find that the underlying formations belong to the upper or barren coal measures.

Overlapping these are the sandstones of the Cretaceous period, which first reveal themselves immediately along the Missouri River about twenty miles west of Omaha, but are found about ten miles westward, as much as eight or ten miles south of the Platte River.

Near the mouth of the Elkhorn, the rusty sandstones of the Dakota group occupy the whole country. Near Columbus, and beyond for twenty or thirty miles, traces of No. 3 Cretaceous are observed, but they are never conspicuous. Nos. 4 and 5 have not been seen along the Platte.

About two hundred miles west of the Missouri River, along the Platte, the light colored clays and marks of the Tertiary period commence, foreshadowed, however, by a thick superficial deposit of fine brown grit, which seems to be of Post Pliocene age, as it is filled with recent fresh water and land strata. *Helix*, *Planorbis*, *Pupa*, *Physa*, *&c.* The Tertiary beds extend uninterruptedly to the margin of the Laramie Range, along the line of the Union Pacific Rail Road.

For one hundred and fifty to two hundred miles west of Omaha the soil is fertile, and, in an agricultural point of view, can hardly be surpassed; but beyond that point there is an absence of wood and water, which will render it impossible to cultivate the west-

ern half of Nebraska successfully. As a grazing country, however, it will eventually prove most valuable. For sheep raising it seems especially adapted. Sheep would thrive well on the short nutritious grasses, and the dry surface strewn with drift pebbles would be admirably adapted to preserve their feet from disease. It seems to me that all this portion of the West may at some period be inhabited by a pastoral people, who will raise some of the finest flocks and herds in America. The soil itself is fertile enough, for the cuttings along the Rail Road show a depth of six to twelve inches of vegetable mould, but there are not streams enough to irrigate any great portion. Even the Platte is sometimes so dry as to have no running water below the junction of the forks. The Platte valley is very broad, averaging five to fifteen miles in width, and on the bottom a good crop of grass grown every year, so that thousands of tons of hay are made for the use of the Government and the Union Pacific Rail Road.

The rocks for building purposes are not abundant anywhere along the Platte east of the mountains, but the materials for making brick or artificial building stone occur in the greatest abundance, scarcely equaled in any part of the world. The vast superficial or Post Pliocene deposits which cover the surface, are especially adapted for these purposes. At Sidney Station and westward, there are some rather thick beds of light brown calcareous grit which seems to answer an excellent purpose for buildings, and has been much used in the erection of round houses and other buildings of the Union Pacific Rail Road. Near Cheyenne City these same Tertiary beds yield an excellent limestone, which has been much used at that place. These Tertiary rocks are rather porous, but work easily, and are sufficiently durable in the absence of more compact rocks.

Along the margin of the Laramie range, about sixteen miles west of Cheyenne City, there are beds of white limestone of Carboniferous age, which, when burned into lime, is of the finest quality. The walls of houses plastered with it are as white as snow, and it is a great favorite with masons. The supply is inexhaustible.

As soon as we reach the mountains, the building materials are as extensive as the range themselves. The sienites predominate, and are of every quality, from compact fine grained, to a coarse aggregate of quartz and feldspar, decomposing readily under atmospheric influences.

I would here call attention especially to some beds of fine grained compact sienite along the line of the Union Pacific Rail Road, near the summit of the first range, which nearly equals the best Scotch sienite, and resembles it very closely. The Union Pacific Rail Road contemplate transporting this beautiful rock to Omaha, to construct with it the piers of the bridge across the Missouri River. I regard this sienite to be as durable, and more elegant for building purposes than Quincy granite.

One of the most important problems for solution affecting the prosperity of this portion of the West, is the possibility of utilizing the vast quantities of coal and iron with which this country abounds. All the coals of Wyoming and Colorado appear to be of Tertiary age; and so extensive are they in the West, that it becomes a question whether the Tertiary might not with more propriety be called the Carboniferous or coal bearing period. I have estimated the coal area north of the Arkansas, south of Lodge Pale Creek, and east of the mountains, at five thousand square miles. It is quite possible that a more careful examination will show that it covers a still larger area.

In connection with this coal are large deposits of brown iron ore or limonite. Vide LeConte's Report, p. 60. There is *no evidence* as yet that the heat-producing power of these coals is sufficient to reduce iron. This iron ore occurs in the form of nodules or concretions, varying in size from an ounce to several hundred pounds in weight. It resembles very closely the iron ore of Maryland and Pennsylvania. It seems to be coëxtensive with the coal beds, though occurring more abundantly at some localities than at others. About twelve miles south of Cheyenne City there are large quantities, and within a few miles, beds of coal five to six feet in thickness are now worked. At South Boulder Creek it occurs again in great quantities, scattered through twelve to fifteen hundred feet of sands and clays connected with the coal. It will doubtless be found in the form of carbonate of iron beyond the reach of atmospheric influences.

The first smelting furnace erected in Colorado was established by Mr. Joseph Marshall, and he informed me that it required about three tons of ore to make one ton of pig iron. Over five hundred tons of this ore have been taken from this locality, and the area occupied by it is over fifty square miles.

There are many other localities on both sides of the mountains where this form of iron ore abounds.

At the sources of the Cherry-water, about thirty miles north

of Cheyenne City, there is a vast deposit of magnetic iron ore of the best quality. Through the kindness of my friend Dr. Latham and Mr. Whitehead, citizens of Cheyenne City, I had an opportunity to visit these iron mines, and I found them much richer and more extensive than I had previously imagined. Worn boulders of this ore have been found in the valley of the Cherry-water for many years. In the report of Capt. Stansbury the following paragraph is found: "In the bed of the Cherry-water and on the sides of the adjacent hills were found immense numbers of rounded black nodules of magnetic iron ore, which seemed of unusual richness."

In the winter of 1859 I gathered a large number of erratic specimens of this ore, which seemed to be scattered in the greatest quantity throughout the valley of the Cherry-water. The snow was so deep that I could not trace the masses to their source. This season I followed these erratic masses up the valley of the Cherry-water and in the mountains, interstratified with the metamorphic rocks, probably of Laurentian age, were literally mountains of this magnetic ore. Mr. Whitehead traced one of these beds a distance of one and a half miles. It occurs in mountain-like masses similar to the ore beds on Lake Superior.

In regard to the coal of this country the evidence seems to be clear that it is probably of Tertiary age. I have traced it over a vast area on the Upper Missouri River, and it seems probable that it extends far northward towards the Arctic Sea. I have also traced the Lignite beds from the Yellowstone valley by way of the Big Horn Mountains to the North Platte, until they pass beneath the White River Tertiary beds, about eighty miles north of Fort Laramie. These beds reappear again about ten miles south of Cheyenne City and continue uninterruptedly to the Arkansas. On the west side of the Laramie range these beds appear again a few miles east of Rock Creek, and from there continue westward to Salt Lake and perhaps farther. In Colorado these coal beds have been wrought to a considerable extent. At South Boulder Creek there are eleven beds of coal varying in thickness from five to thirteen feet. The lowest bed is thirteen feet in thickness and is of excellent quality, very much resembling anthracite in appearance, though much lighter.

An analysis of this coal by Dr. Torrey of New York, shows it to contain 59.20 per cent. of carbon — water in a state of combination or its elements 12.00 — volatile matter expelled at a red heat forming inflammable gases and vapor 26.00 — Ash of reddish color, color sometimes gray, 2.80.

As a fuel for domestic purposes I am convinced that this coal will rank next to anthracite and prove superior to the ordinary bituminous coals. It is as neat as anthracite, leaving no stains on the fingers. It produces no offensive gas or odor, and is superior in a sanitary point of view; and when brought into general use it will be a great favorite for culinary purposes. It contains no destructive elements, leaves very little ash, no clinkers, and produces no more erosive effects on stove grates or steam-boilers than dry wood. If exposed in the open air it is apt to crumble, but if protected it receives no special injury. Dr. Torrey thinks there is no reason why it should not be eminently useful for generating steam and for smelting ore.

In the Laramie Plain along the line of the Union Pacific Rail Road extensive beds of coal have been opened, and the coal is used for generating steam and for fuel on the cars. It cannot be long before it will come into general use throughout the West.

August 15th. Left Cheyenne City with Dr. Curtin, an assistant on the Survey, and Mr. Whitehead, a citizen of Cheyenne City, for the purpose of exploring the Cherry-water valley to its head. For the first twenty miles we passed over the light colored marls and sands of the White River Tertiary. As we approached the foot of the mountains we came into a beautiful valley, varying from three to ten miles in width, looking as though it had been scooped out as it were during the Glacial period by forces from the mountain sides. All over this country are marked proofs of a powerful erosion at the close of the Drift period, which gave to the surface of the country its present configuration. There are terraces also along the base of the mountains as well as along the stream, and the nearer we approach the mountain slopes the more conspicuous these terraces become.

We camped the night of the 15th on Horse Creek, a branch of the North Platte. This valley can hardly be surpassed for grazing purposes. The water is excellent and the grass good. Near the point where the creek issues from the foot hills of the Laramie range there is a series of upheaved ridges with a strike nearly east and west, the beds inclining from 50° to 70°. The series of strata seems to be nearly as complete as that observed southward towards Denver. The red arenaceous beds are well shown, but no gypsum was seen.

In the valley of the Cherry-water near the fount whence its branches issue, the rocks are elevated at various angles, and by their great variety of color give a most picturesque appearance

to the scenery. Inclining away from the sienite nucleus we have here, 1st, the red arenaceous beds, 1000 to 1500 feet in thickness, then, 600 to 800 feet of variegated marls and clays with layers of sandstone, all destitute of fossils or any evidence of their age. These beds incline south-west at various angles 19°, 11°, 6°, &c. Then the cretaceous beds are quite well represented. From No. 5 I gathered *Baculites ovatus* and an *Inoceramus*.

Upon the Cretaceous beds, but not conforming to them, rest the White River Tertiary beds, inclining at a small angle, as if they had partaken of the latest upward movements of the mountain ranges.

The central portions of the mountains are composed of sienite mostly. The outer beds are rotten sienite of a dull gray color, disintegrating to such an extent that the surface is covered with a thick deposit of crystals of feldspar. As we approach the dividing ridge the beds of sienite become more compact and durable. Now and then we find beds of hornblendic gneiss or white quartz. All these rocks are nearly vertical.

Intercalated among these beds of sienite we found the beds of iron ore which, though not continuous like the sienite, occur here in large quantities. The ore beds incline in the same direction with the others, with the same joints and clearage, and the surface of many of the layers has the appearance of slickensides. Thousands of tons of this ore have been detached from these beds and distributed throughout the valley of the Cherry-water in a more or less worn condition. Although the amount of iron ore which we were able to discover, was indefinite in extent, yet we had evidence of the existence of other beds in the mountains at the sources of all the branches of the Cherry-water.

The Cherry-water empties into the North Platte, and has a valley about one hundred miles long. It has been for many years a favorite locality for wintering stock, not only for the excellence of the grass and water, but also from the fact that the climate is mild throughout the Winter. Cattle and horses thrive well all Winter without hay or shelter. The soil in all the valleys of the stream that flow into the North Platte is fertile, and where the surface can be irrigated good crops of all kinds of cereals and hardy vegetables can be raised without difficulty.

While my explorations this season will be confined mostly to the plain country, yet my plans contemplate numerous side trips to interesting points in the contiguous mountains.

Within a few weeks a great excitement has been created at

Fort Sanders and Laramie City, by the reported discovery of rich gold diggings near the sources of Little Laramie River. This district has a regular organization, hundreds of claims have been staked out and the name of "Last Chance" diggings given to it. Some very large and valuable nuggets of gold have been taken from these mines, and the usual exaggerated reports of their richness have been circulated everywhere.

August 20th. I started from Fort Sanders to make an examination of this district under the auspices of Maj. Gen'l Gibbon, U. S. A., the commander of the Rocky Mountain District. We were so fortunate also as to have the company of Prof. James Hall, State Geologist of New York. Our course was nearly south-west up the valley of the Little Laramie River to its sources in the Snowy Mountains. From Fort Sanders to the Little Laramie River the distance is eighteen miles over a very nearly level country, underlaid by Cretaceous beds holding a horizontal position nearly. Nos. 2 and 3 are quite well shown. No. 2 with its dark plastic clays is first observed at the Big Laramie Stage Station, six miles west of Fort Sanders.

In the broad, level plain country, west of this point No. 3 attains a thickness of fifty to one hundred feet, sometimes exhibiting its usual chalky character, but mostly composed of thinly laminated calcareous shale. All through it are thin layers of fibrous carbonate of lime, the fibres at right angles to the plane surface, and attached to these masses or layers are myriads of the little oyster *O. Congesta.* I also found a number of the vertebræ of a saurian animal.

From the Stage Station we passed directly up the valley of the Little Laramie. On either side were long ridges covered with grass and water-worn rocks, but from their sides projected a bed of rusty sandstone which contained *Inoceramus* and other marine fossils, which indicate the upper Cretaceous or No. 5. These beds continue for about fifteen miles, to a point where the river issues from the foot hills of the mountains, and thence to its source we follow its windings through some most beautiful and rugged scenery. The river itself has wrought its way through a synclinal valley caused by two separate minor ranges projecting out from the main range of mountains, and the trend of the minor ranges is nearly north and south.

One of these small ranges is quite peculiar in its character. On its east base, which fronts the Laramie Plains, the upper Cretaceous beds jut up against its side, and no unchanged rocks

of older date are seen, while on the west side, about five miles distant in a straight line, the entire series from the Carboniferous to the summit of No. 3 Cretaceous are visible, inclining at greater or less angles from the slope. The nucleus of the mountains is sienite of various degrees of fineness and compactness, inclining from 50° to 70° towards the south-east or nearly east.

It is an important question to determine the exact relation of these metamorphic rocks, which form the central portion of all the mountain ranges, to the unchanged beds which usually incline from their sides. Do they conform to each other or not? Did the metamorphic rocks lie in a more or less inclined position prior to the deposition of the Silurian or Carboniferous beds upon them? We have thus far found it difficult to determine the conformability or nonconformability west of the Laramie range; but on the east side of the mountains, especially near Fort Laramie and along the eastern slope of the Big Horn and Wind River Mountains, the discordant relation of the two series of rocks is very apparent. These questions will have a most important bearing when we attempt to reconstruct the history of the physical revolutions which have occurred in the West during past geological epochs. The sienite beds which form the nucleus of the small range of mountains between the Big and Little Laramie Rivers inclining eastward, were pushed up in such a way that the east front is almost vertical, and the Cretaceous beds at the base, which must have been borne upward in part during the elevation, have fallen abruptly down, so that in some instances they have passed the vertical position 20° to 30°. East of the Big Laramie and all along the western slope of the Laramie range, the entire series of unchanged rocks are visible, inclining at moderate angles from the mountain sides. On the west of this range the slope is more gentle, and the Carboniferous, Triassic and Jurassic and Cretaceous beds present their upturned edges clearly to the scrutiny of the geologist. The synclinal valley here through which the Little Laramie flows is about five miles wide, and crossing this stream west we find the full series inclining from the mountain slope eastward. The dip of the red beds is from 40° to 60°, that of the Cretaceous 40°.

No fossils have been found in any of the unchanged rocks below No. 3 Cretaceous west of Fort Sanders, nor does the nature of the beds indicate that the physical conditions during their their deposition were favorable for the existence of animal or vegetable life, certainly not for the preservation of its remains.

Between the well marked Cretaceous beds and the metamorphic rocks nearly all the rocks are brick-red, or tinged more or less with red from the presence of the peroxide of iron, and diffused through them there is a certain amount of gypsum; hence they have been called gypsiferous deposits. In the Black Hills, Big Horn and Wind River Mountains these red beds are largely developed, and there they contain beds of beautiful white amorphous gypsum, varying in thickness from five to sixty feet. Along the east slope of Pike's Peak in Colorado these formations contain valuable beds of gypsum, but in the Laramie Plains I have as yet observed no regular beds. The thickness of these deposits was estimated by Prof. Hall to be about 3000 feet, while the Cretaceous beds were 500 to 800 feet thick.

Camping with our wagons at the base of the main range of mountains near the source of the Little Laramie, we prepared to ascend the mountains on horse-back to the gold mines; the distance was about ten miles before we came in view of the "diggings," and to reach them made an ascent of about 2000 feet above the bed of the creek. We were then between 10,000 and 11,000 feet above the sea, very near the elevation of perpetual snow and where frost occurs every night of the year. On the summits of these lofty mountains are some most beautiful open spots without a tree, and covered with grass and flowers. After passing through dense pine forests for nearly ten miles, we suddenly emerged into one of these park-like areas. Just in the edge of the forest which skirted it were banks of snow six feet deep, compact like a glacier, and within a few feet were multitudes of flowers, and even the common wild strawberry seemed to flourish. These mountains are full of little streams of the purest water, and for six months of the year good pasturage for stock could be found.

The gold is sought after in the gulches that are formed by the little streams that flow from the Medicine Bow and other snowy mountains, most of which flow into the North Platte. We labored for two days to discover the quartz seams which we supposed to be the source of the stray lumps of gold, but the great thickness of superficial drift which covers all these mountains, concealed them from our view. The gold as far as known in this district seems to be confined to the lower glacial drift. That valuable mines will be found in these mountains at no distant day seems very probable. The geological evidence is quite conclusive, and the mountains are a continuation northward of

the same range in which the rich mines of Colorado are located.

Not only in the more lofty ranges, but also in the lower mountains, are large forests of pine timber which will eventually become of great value to this country. Vast quantities of this pine in the form of rail road ties is floated down the various streams to the Union Pacific Rail Road. One gentleman alone, has a contract for 550,000 ties, all of which he floats down from the mountains along the southern side of the Laramie Plains. The Big and Little Laramie, Rock Creek, and Medicine Bow River, with their branches are literally filled with ties at this time, and I was informed that in time of high water they can be taken down to the railroad from the mountains after being cut and placed in the water, at the rate of from one to three cents each. These are important facts, inasmuch as they show the ease with which these vast bodies of timber may be brought down into the plains below and converted into lumber, should the future settlement of the country demand it. I am inclined to believe that a peculiar class of people, like the lumbermen of Maine and Michigan, will some day fill these mountain regions.

There are several species of pine wood and one spruce or balsam of fir, *Abies Douglassi*. The latter is a beautiful and symmetrical tree, rising to the height of 100 to 150 feet and as straight as an arrow. The ties that are made from this spruce are of the best quality.

On the morning of *August 25th*, I left Fort Sanders on a third side trip to the North Park, in company with a hunting party composed of Gen'l F. P. Blair, Col. Dodge, U. S. A., and Capt. Proctor, U. S. A. Messrs. Smith and Carson, assistants, accompanied me. The examination of the North Park forming a part of my plan of operations, I regarded this as the most favorable opportunity that was likely to present itself, affording adequate protection. I was the more desirous of visiting that interesting locality from the fact that the geological character is entirely unknown.

Our course from Fort Sanders was nearly south-east up the Big Laramie River towards its source in the mountains. The geology of the plain country through which the Big Laramie flows is very similar to that of the Little Laramie — about fifteen miles to the westward. There are comparatively few exposures of the basis rocks on account of the superficial drift which covers all this country. Still we find along the banks of the river, near the Stage Station, the same black plastic clay of

No. 2 with *Ostrea congesta* and a few remains of fishes; also the chalky marls of No. 3; and about two miles above, the long high ridges, on either side, extending up for several miles, composed of the rusty yellow sands and sandstone of No. 5. The dip of these beds is very gentle, hardly perceptible to the eye.

The Big Laramie is a very clear stream, about fifty yards in width and averaging about two feet in depth, easily forded in most places. Like most of the western streams, the difference between high and low water mark is very great. In Spring and early Summer, when the snows of the mountains melt, these streams become formidable rivers. The soil along the bottoms appears to be very good, the grass grows quite heavily and hundreds of tons of hay are cut here by the settlers for Winter use. The grazing is excellent, and numerous ranches have been started all through the valley for the purpose of raising stock. Even at this season of the year a great variety of flowers covers the surface. The *Compositae* and *Leguminosae* prevail in numbers, and yellow is the dominant color. As we approached the foot hills of the mountains the transition beds or No. 1 (?) appeared on the ridge, rocks of more recent date having been swept away by erosion. Fragments of pudding stone and rusty colored masses of sandstone were scattered here and there; then beneath them were exposed about 400 feet of variegated arenaceous layers of uncertain age, perhaps Jurassic; then a little higher up the side of the mountains were revealed the red beds 1500 feet or more in thickness, presenting wonderfully picturesque scenery. All these beds seemed to have been lifted up in a nearly horizontal position, so that they present lofty escarpments, sometimes cone-like or pyramidal in shape, revealing each layer in the order of succession. The harder layers yielding less readily to atmospheric influence, project out from the sides adding much to the novelty of the view. Most of the beds incline from the flanks of the mountains at various angles, 3°, 8°, 15°, and then continue along the river winding for twenty-five miles among the mountains almost to the foot of the snow covered peaks.

On either side can be seen a number of sienitic nuclei, but I could not find the unchanged rocks so clearly in contact with them that I could define their relation to each other.

Before reaching the mountains we passed a series of alkaline lakes which are simply shallow depressions, receiving the drainage of a small area without any outlet. From these shallow

lakes the water is evaporated, so that in the Autumn the bottoms are dry and covered with a white incrustation which looks much like water in the distance. One of these lakes still contained water and seems to have a fair supply at all seasons. It is almost a mile in length and half a mile in width. In the Spring these lakes are quite large and are filled by the overflow of the branches of the Big Laramie, which are greatly swollen by the melting snows. Great quantities of fish are swept into these lakes from the neighboring streams, and in the Autumn the water becomes so alkaline by evaporation that the fish die in great numbers along the shore. It is a curious fact that not a single trout has ever been taken in any of the branches of the North Platte unless a few have been caught in the Sweet-water, while the branches of the South Platte are filled with them.

After entering the foot hills of the mountains the Big Laramie and its branches wind their way through the narrow valleys or gorges formed by the anticlinals and synclinals produced by the upheaval of the unchanged rocks.

All the lower beds are more or less arenaceous and of a brick-red color, with only three layers of a light gray sandstone. No fossils can be found in any of the rocks, so that it is difficult to determine their age with certainty. We believe that the lower beds are Carboniferous, and have received their red color from the fact that the sediments were doubtless derived from the disintegration of the red sienitic rocks upon which they rest. It is also quite possible that a portion of the red beds are Triassic, and also that the yellow, gray and rusty sands and sandstones above are Jurassic.

Lying above the supposed Jurassic and beneath the well defined Cretaceous there is a large thickness of sandstone which I have called Transition beds or No. 1 (?), because they occupy the position of the lower Cretaceous No. 1, as shown on the Missouri River and in Middle Kansas. These beds are well developed and quite uniform in their lithological character all along the mountain sides from latitude 49° to the Arkansas, yet they have never yielded a single characteristic fossil that would determine their age. I have therefore called them provisionally Lower Cretaceous or beds of transition from one great period of geological history to another, and the characters of the sediments which compose them justify the name.

Near our camp on the Big Laramie, which was about thirty-five miles south-west of Fort Sanders and about fifteen miles

above the foot of the hills, were some singular illustrations of the dynamics of geology. On the south-west side of the stream and inclining eastward or south-eastward the entire series of red and variegated beds are shown in their order of succession 1500 to 2000 feet in height. At the foot of this escarpment is a low ridge of the red material, which is so grassed over that the connection cannot be seen with the sienite nucleus. This covers a belt of sienite, about two hundred yards wide and three to five miles long, the jagged masses of rock reaching a height of one thousand feet or more, and standing nearly vertical or dipping slightly to the south-east. Between the sienitic beds and the river are the two low ridges of Cretaceous No. 2 and 3 which seem to have been lifted up with the sienite, but to have fallen back past a vertical position, so that they now incline from the sienite ridge, while on the opposite side the beds have a regular dip from the ridge. This peculiarity seems to be common in various localities, owing to the fact that the metamorphic beds which composed the central portion of all the mountains had suffered upheaval prior to the deposition of the unchanged beds. Therefore in the quiet elevation of the mountain ranges the beds are merely lifted up in the direction of the dip of the older rocks, while they are as it were pushed away from the opposite side, forming what may be called an abrupt or incomplete anticlinal.

On the opposite or south side of the river there is a gradual slope of 2000 feet above the bed of the stream, the strata inclining 5° until we reach the nucleus of another mountain range; so that we have here as it were two huge monoclinals. These monoclinals form local anticlinals, inasmuch as, in some places, all the beds incline for a short distance from a common axis.

On the north side of the river, and east for ten to twenty miles, the flanks of the mountain ranges are covered with the unchanged rocks, which give comparatively gentle grassy slopes, owing to the readiness with which they yield to atmospheric agencies. Through these slopes many little streams cut their way, forming huge cañons, which exhibit along their sides the series of beds in their order of succession.

From a point near the source, for twenty or thirty miles, the river flows through a synclinal valley, the conspicuous red beds dipping from either side. Along the valley of the river are marked deposits of drift, the result of glacial action; but the most beautiful feature is the well defined terraces, about fifty feet high and smoothed off like a lawn. These terraces are

covered with a considerable deposit of drift; but when they are cut through by streams the basis rocks are shown.

The scenery on either side of this valley is beautiful beyond description. On the west side are the snow-clad peaks of the Medicine Bow range in the distance, with numerous intervening lower ranges ascending like steps. The snowy mountains are mostly destitute of vegetation and are covered with eternal snow, but the lower mountain ridges are covered mostly with what may be called groves of pine. Indeed the pine groves and grassy openings are so arranged and proportioned that the whole scene appears as if it might have been partially the work of art, and the traveler imagines himself in a sparsely settled mountainous district instead of the unexplored Rocky Mountain Region. These openings and grassy slopes will make excellent pasture grounds, for the grass is good, and they are watered with the finest of mountain streams and springs. I would again remark that the pine forests of these mountains must at some period be an object of earnest pursuit. Even now the mountain sides are full of tie cutters, who cut and float hundreds of thousands of ties down the mountain streams fifty to one hundred miles to the Union Pacific Rail Road, whence they can be transported by rail road to any desired point.

In the moist ravines of the mountain sides are patches of the aspen *Populus tremuloides*, which from their peculiar mode of growth, form a striking feature in the landscape. They grow very thickly, seldom attaining a height of more than forty or fifty feet, and not more than twelve to eighteen inches in diameter. The bodies are very smooth and nearly white, and their tops form a rounded cone shaped mass of foliage. These aspen groves are the favorite resort of deer, elk, grouse, and all kinds of game.

On the east side also is the snow clad range, which in its southward extension includes Long's Peak and numerous other peaks in the vicinity. On either side of these lofty ranges, which often rise above the limit of vegetation, are a number of successive lower ridges which descend like steps. There is such a wonderful uniformity in the structure of the mountains that a detailed description of a portion applies for the most part to all.

Our course along the Cherokee Trail was about south-west from the Big Laramie River, over ridge after ridge, and after traveling twenty-five miles, we entered the North Park through some of the most beautiful scenery of that interesting region. From the summit of the high ridges on the north we looked to

the southward over a series of lofty cones or pyramids, as it were, all clothed with a dense growth of pine. The metamorphic rocks of which these mountains are composed disintegrate so easily that the surface is covered with a deposit of loose material, as fine earth and fragments of rock. The hills have therefore been so smoothed down that it is difficult to see the basin rocks in continuous lines. We saw enough however to show us that red sienite in its various forms constitute the principal rocks, while now and then a bed of hornblendic gneiss, white quartz or greenstone, occurs. All through the mountain region are small open areas, sometimes on the hills and sometimes on the lower ground, forming meadow like spots which the various kinds of animals love to frequent to feed on the abundant grass. The Old Cherokee Trail derives its name from the fact that a party of those Indians cut their way through the thick pines about thirty years ago with a train of three hundred wagons.

The traveling was difficult at this time, owing to the ruggedness of the surface and the obstruction from the fallen pines.

So far as I could ascertain it, the trend of the upland mountain ridges of sienite was nearly east and west, and the dip nearly north. The North Park is oval or nearly quadrangular in shape, is about fifty miles in extent from east to west, and thirty from north to south, occupying an area of about fifteen hundred square miles. Viewing it from one of the high mountains on its border, it appears to be a vast depression which might once have formed the bed of a lake. Its surface is rather rugged, yet there are broad bottoms along the streams, especially the North Platte and its branches. Scarcely a tree is to be seen over the whole area, while the mountains which wall it in on every side are dotted with a dense growth of pine. The grass grows in the park quite luxuriantly, often yielding at least two tons of hay to the acre. Streams of the purest water flow through the Park, and there are some of the purest springs I have yet seen, a few of them forming good sized streams where they issue from the ground. I am quite confident that this entire Park would make an excellent grazing region for at least six or eight months of the year. Myriads of Antelope were quietly feeding in this great pasture ground like flocks of sheep. The soil is very rich, but the seasons must be too brief for successful cultivation of any crops. Indeed there is frost there nearly every night, and snow falls every month of the year.

As I have before stated, the Park is surrounded with lofty ranges of mountains as by gigantic walls. On the north and

east side may be seen the snow covered ranges rising far above all the rest, their summits touching the clouds. On the west side there is also a short snowy range. The snowy ranges on the east border of the Park have their north sides abrupt and south sides less so as seen from a distance, as if the massive rocky hills inclined southward. All along the north side of the Park the lower hills incline south-westward, while the higher ranges are quite steep, and correspond in the apparent dip of the beds to the lofty snow clad mountains on the east which incline south or south-westward. The inclination of the metamorphic beds composing the higher ranges is from 60° to 80°. On the west side of the Park long ridges seem to slope gradually down, so that they die out in the plain, forming a sort of "en echelon" arrangement. It is due to this fact that the area enclosed receives its oval shape.

The general trend of all the continuous mountain ranges is nearly north-west and south-east on all sides, but there are many local dips and variations from this direction.

I was much interested to know whether any of the unchanged rocks which are so well developed in the Laramie Plain occur in the North Park. I found that the entire series of red and variegated beds, including a portion of the Cretaceous strata, were fully represented, all inclining from the flanks of the mountains, and gradually assuming a horizontal position or nearly so toward the central portion of the Park. The transition beds or Lower Cretaceous, No. 1 (?), form quite conspicuous ridges inclining 19° to the south-west. They are composed of a very beautiful pudding stone of small rounded pebbles, most of them flint, cemented together with a siliceous paste. On the north side are quite large areas covered with loose sand which is blown about by the wind, resembling the sand hills on the Niobrara River. A close examination of the sand shows that it is composed mostly of worn particles of quartz and feldspar. The surface contains little or no vegetation presenting a peculiar barren appearance, the sand moving readily with the wind.

Hitherto it has been impossible to color on any geological map the geological formation of any part of this mountain region, and no information has ever been given in regard to the structure of the North Park. It will be impossible even now, with the imperfect topography of any of the maps, to color the geology in detail, but these explorations will enable me to fix the outline of the formation in a general way with a good degree of accuracy.

Stated Meeting, October 16, 1868.

Present, thirteen members.

JOHN C. CRESSON, Vice-President, in the Chair.

Donations for the Library were announced from the Academies and Societies at St. Petersburg, Berlin, Vienna, Moscow, Görlitz, St. Gall and Lausanne, the Geological Societies at Berlin, Vienna and London, the Berlin Horticultural Society, London Antiquarian Society, Cornwall Polytechnic Institute, Annales des Mines, Herr Hofrath Heidinger, Dr. Le Conte, Dr. H. C. Wood, Mr. John Biddle, and Senator Sumner.

Nominations Nos. 589 to 592 were balloted for, and new nominations Nos. 593, 594, were read.

On motion of Mr. Fraley, the Michaux Committee were requested to report.

On motion of Mr. James, Prof. Cope received permission to withdraw his paper on the Origin of Genera.

The Committee on Dr. Wood's Memoir on Phalangia and Pedipalpi, reported in favor of its publication in the Transactions, which was ordered.

The following gentlemen were declared duly elected members:

Charles E. Anthon, LL.D., Prof. of History and Belles Letters in Columbia College, New York City.

O. C. Marsh, Professor of Palæontology in Yale College.

Traill Green, M. D., Prof. of Chemistry in Lafayette College, Easton, Pa.

Wm. M. Canby, Esq., of Wilmington, Del.

And the Society was adjourned.

Stated Meeting, November 6th, 1868.

Present, nineteen members.

JOHN C. CRESSON, Vice-President, in the Chair.

Letters accepting Membership were received from Mr. Wm. M. Canby, dated Wilmington, Del., Oct. 21, 1868; from Dr. Traill Green, dated Easton, Pa., Oct. 21, 1868; and from Prof. Charles E. Anthon, dated College of the City of New York, Oct. 28, 1868.

Letters acknowledging the receipt of the last issue of Proceedings were received from the Massachusetts, New Jersey and Chicago Historical Societies, Essex Institute, and New York Lyceum.

A request for publications to complete a series in the Public Library of Boston, was on motion granted.

Donations for the Library were received from Dr. Gesellius, the Imperial Geographical Society, St. Petersburg, Professor Zantedeschi, the Victoria Society, Melbourne, the Paris Geographical Society, the Royal Astronomical and Antiquarian Societies, London, the Boston Natural History Society, Rhode Island and Wisconsin Historical Societies, Professor Anthon, of N. Y., the Franklin Institute and Medical News, Gov. Rawdon, of Nassau, Dr. J. Wyman, of Cambridge, and the Secretaries of the Republican National and Congressional Committees.

Mr. Lesley, pursuant to appointment, read an obituary notice of Wm. Parker Foulke, a deceased member of the Society. Mr. Price added remarks respecting Mr. Foulke's professional life and character.

Nominations Nos. 593, 594 were read.

Mr. Peale, moved an appropriation of $231 60 to pay for the picture (and frame) of Dr. Franklin Bache, which was made, and the committee discharged.

The Michaux Legacy Committee begged leave to report at the next meeting.

And the Society was then adjourned.

OBITUARY NOTICE OF WM. PARKER FOULKE.

Read before the American Philosophical Society,

By J. P. Lesley.

William Parker Foulke was born at Philadelphia in 1816; was entered as a law student in the office of John B. Wallace, in 1835; continued his legal studies, on the death of Mr. Wallace, in 1837, with John M. Scott; became practising attorney of the Supreme Court of Pennsylvania in January 1841; was married to Julia De Veaux Powel in 1855; and died, at his town residence in Pine street, on the 18th day of June, 1865, in the fiftieth year of his age.

Mr. Foulke was elected to membership in this Society October 20th, 1854, and served it in the Board of Officers and Members in Council from January 1863 until his death. For more than ten years he was a regular assistant at its meetings, and took the greatest personal interest in the doings of the Society; proud of its fame, jealous of its honor, and unremitting in his efforts to direct and enlarge its active usefulness. He possessed uncommon administrative ability. Few men could see so quickly and directly through a complication. None surpassed him in an extempore statement. He was gifted with good judgment as well as with persuasive speech.

The attachment which he exhibited to this venerable institution was in part hereditary; for his grandfather, Dr. John Foulke, became a member of it January 20th, 1786, and afterwards one of the secretaries of the Society. Dr. Foulke was the earliest demonstrator and lecturer on human anatomy in the Medical College of Philadelphia; a polished and liberal man, zealous and humane. During the epidemic of yellow fever he would be absent from his home for several days at a time, devoting himself to medical attendance on the sick in the infected district. There was a tradition in the family that his wife, returning home one day, discovered to her dismay, that every quilt and blanket she possessed had been swept from her beds by the Doctor's orders, and sent where he considered them of more immediately pressing use. Nor was he less enthusiastic in his pursuit of science, and in his methods of instruction. On his return from France, where the balloon had lately been invented, he exhibited one for the first time in America, on the

occasion of a lecture on Pneumatics, at the old hall of the College of Medicine, in Fourth street below Arch, to the great delight of his scientific friends.

Two streams, Philanthropy and Philosophy, ran naturally then through the veins of our departed friend and fellow member. The story of his life divides itself into these two chapters. His love of knowledge not only attracted him to the room in which we sit, filled with souvenirs of men, whose portraits surround us and represent the highest thinkings of the early days of the nation, — and to the rooms of the Academy of Natural Sciences, of which he became a member in November 1849, — but it attached him to the society of educated citizens whatever might be the special ground of their association; and of cultivated foreigners who visited our city. His membership in the Historical Society of Pennsylvania commenced as early as January, 1842, and his interest in its proceedings never flagged.

On the other hand, his warm heart, his sympathy with suffering wherever he saw it, his clear comprehension of the duties of society towards its unfortunate classes, working under the guidance of an uncommonly well balanced intellect, gave him an early and advanced position in the ranks of Christian Philanthropists. It was in 1845 — he was twenty-nine years old — when he took hold of two of the principal reforms of the age, and it may almost be said that he made one of them his own.

In October of 1845 he became a Manager of the Pennsylvania Colonization Society; and was sent as a delegate to the Annual Meetings of the mother Society held at the seat of government in 1853, 1854 and 1855, in which last year, he wrote, as Chairman of the Committee, its report of "plans, for taking steps to obtain a completion of the partial exploration by the Government of the United States of the country lying east of Liberia." In his message of 1852, the President of the United States had published the fact that incipient measures had been taken towards the reconnoisance of the Continent of Africa, east of Liberia, directing Commander Lynch to attach himself to the squadron for that duty.* Mr. Lynch's report was made to the Secretary of the Navy from Philadelphia, September 5, 1853.†

This reconnoisance was due to the earnest solicitations of the Pennsylvania Society, under the influence of Mr. Foulke, that

* Annual Report A. C. S. Jan. 18, 1853, p. 13. † H. Doc. 1. 64 pages.

the stream of emigration should be directed no longer upon the unhealthy coast, but to the salubrious interior of the continent; that stations should be selected in the hill country, and easy communications be established with the ports.* But there was a secret spring of opposition to the scheme, among the representatives of certain portions of the slave-holding population of the South, which all the zealous efforts and enlightened arguments of Mr. Foulke and his fellow philanthropists could not stop. He often used to rehearse his adventures in the Capitol, and among them all the following was not the least instructive and discouraging: "On the night before the day when he expected the final passing of the Bill to secure the appropriation of the $25,000 necessary for the prosecution of the exploration, he was talking with a certain Senator in a parlor of the hotel. At the close of their interview, this gentleman, striking his hand upon the mantlepiece, said vehemently, 'By ——, Mr. Foulke, you shall have your Bill, I'll vote for it!' It was nevertheless the 'No' of this man which on the following day turned the scale against the accomplishment of the desired project. The Bill was lost by *one* vote, and that was the vote of Senator Hunter, who had given him this pledge."

Nothing came of this attempt to complete the exploration; but its record is made interesting, in this memoir, by its relation to the arduous and entirely successful efforts which Mr. Foulke made, in after years, to set on foot the second expedition to the North Pole, commanded by Dr. Hayes. At the same meeting in Baltimore, 1855, Mr. Foulke, as chairman of another Committee on the apportionment of the representation of the State Societies, read its report, written evidently by himself, with his usual forcible statement and skillful arrangement of the divisions of his theme. The Constitution of the Colonization Society was a kind of parody of the Constitution of the United States, which permitted the discussion of political principles belonging to twenty or thirty millions of people, within the narrow limits of a Society which managed to ship five or six hundred emigrants, per annum, and whose entire income ranged between fifty and a hundred thousand dollars. In 1857 Mr. Foulke, as chairman of a committee "to consider the policy of the friends of Colonization, and to report such recommenda-

* See Mr. Foulke's letter to the Nat. Intelligencer, July 1856.

tions," &c., read the report, which he had written; and his admirable style is manifest throughout. His interest in this and various other plans to extol and strengthen the colonization scheme, was inspired by a genuine anti-slavery sentiment, and never lost its zeal. He was elected Vice-president of the State Society in 1863, only eight months before he died.

Mr. Foulke became a member of the Philadelphia Society for Alleviating the Miseries of Public Prisons in July, 1845. In the following November he appears as one of the Acting Committee; and in May, 1846, as one of the visiting Committee for the Eastern Penitentiary. From that time he was indefatigable in his attention to his assumed duties. He studied the subject of Prison Discipline profoundly. He allowed no statement for or against the peculiar Pennsylvania plan of Separation to escape him. He examined into the results obtained at Penitentiaries conducted under other kinds of discipline. He assisted his friend Haviland, the Architect, in devising improved ground plans, elevations and arrangements for new gaols. In all that he wrote on the subject, and it was not a little, one must respect the well studied statements of a thorough bred lawyer, the well balanced judgments of an unprejudiced investigator, and the ardor of a benevolent heart.

Most of his papers on this subject were published in the Journal on Prison Discipline and Philanthropy, a quarterly journal of ninety-six pages, two numbers of which had appeared when he was appointed, April, 1845, its editor. He edited four numbers and then resigned, because of other duties. These papers afterwards appeared as separate pamphlets, to be distributed to those who felt an interest in the cause.

In March, 1846, he presented for adoption by the Acting Committee a memorial to the Legislature asking for the passage of a law to secure accurate returns of facts from all the county jails, to serve as a basis for a full Annual Report of Criminal Statistics. In the autumn of that year he made an extensive tour in Pennsylvania and Maryland, to visit county prisons, and published a report of their discipline and condition, which attracted general attention, and produced some needful legislation in the right direction, but not until after voluminous correspondence, and his personal exertions at Harrisburg. Nothing but that tact which characterised him in all his undertakings could have

secured the hoped for result. No man ever exhibited a more refined courtesy towards all kinds and classes of persons. His careful considerateness, his manly concession to prejudice, and to peculiarities of temperament, and his persuasive statement of the points he wished to carry, smoothed away before him all difficulties. But the execution of a law demanding such accurate and uniform reports as were indispensable for his object was found to be less easily attainable than its enactment. On his return from Harrisburg he reported a visit to the Lancaster Jail, which brought about action in the Society resulting in the erection of a new first class prison in that place.

In 1847 he published a description of the New Bucks County Prison. "We look upon its erection," he writes, "as a harbinger of good to the State at large. . . . . Thus may we at length accomplish a general reform, which has been too long delayed." Heated and ventilated on the best plan, furnished with baths and every other needful convenience for health, he looked upon this prison as a model.

In the spring of 1850 he submitted the draft of a new law to procure uniformity of jail erection and discipline throughout the State upon the separate system, discriminating between the different classes of detained persons, and providing for the comfort and health of all.

In March, 1851, he published a detailed report of a plan for the New Schuylkill County Prison; and afterwards a description of the same prison erected by Le Brun. "It would be scarcely credible," he begins, "had we not the unqualified fact before our eyes, that our government has permitted county after county to build public prisons in open defiance of the clearly expressed policy of our Legislature; and that, except when the Prison Society of Philadelphia has urged the subject upon the attention of our lawgivers, absolutely nothing has been done towards compelling county officers to give effect, within their jurisdiction, to the design of our laws in relation to public discipline. To our shame be it acknowledged, that while we boast of our reforms, and of their triumphant influence abroad, we are neglecting the most important of our penal institutions. Without a bureau, or even a clerk, or a clerk's cabinet, appropriated to the subject of prison administration; without a report worth the name, upon the condition of jails throughout the State; with a law upon our

statute book which requires annual returns of information, and which is generally unexecuted, although less than five years old; we are content to permit the expenditure of funds, raised by taxation of our people, upon structures, the very ground plan of which is manifestly irreconcilable with the penal system which we are pretending to enforce under the authority of State laws, within the walls of State penitentiaries."

In these words we see the motive that animated our friend in his long struggle with popular prejudice and indifference, in behalf of those whose imprisonment was demanded not by vengeance but by social necessity. He congratulates his fellow citizens of Schuylkill County in their choice of public officers, "who have known how to disregard the paltry suggestions of a misjudged economy, and who have not hesitated to expend the public funds in accordance with the policy of our jurisprudence, and with a regard to the rights of individuals, as well as to the security of the community."

Early in 1851 Mr. Foulke and another member of the Acting Committee, went to Harrisburg to secure the passage of a law such as has been mentioned above. In April they report the success of their arduous labors. The law required the transmission of careful plans for every new county prison to the Secretary of State for his approval. Preparation was now made to furnish such plans when needed, and Mr. Foulke devoted unremitting attention to this work, and his published descriptions of model county prisons, extensively distributed within and without the limits of the State, exhibit his intelligence, discrimination, business capacity and industry.

The summer of 1851 was an active one for him. He reported his tour of visitation to Columbia, Montour, Union, Northumberland, Dauphin, Blair and Berks County Prisons. Some of his reports were minute and laborious. In the following summer he reported at large upon the state of the Berks County Prison: no detail of the building arrangement, discipline, or resulting experience seems to have escaped his practised and philanthropic eye.

In 1852 Mr. Foulke wrote a cordial obituary notice of his friend Haviland, the Architect of the Eastern Penitentiary Buildings, wherein he incidentally states the nature of the philanthropic end which he himself kept steadily so many years in view.

"The visits of Howard to the prisons of Europe, had brought to public notice not only the miserable condition of the discipline in most of them, but also many of their principal defects of construction. The modifications of interior arrangement first suggested for convicts in England, and subsequently enlarged and carried into successful operation in Pennsylvania, required great alterations of material structure. The design was to pass from a state of things, in which there was an indiscriminate association of prisoners without labor, without instruction, without government, almost without restraint, except that of walls, chains, and the brutal tyranny of the strongest or boldest among the prisoners, to a state in which separation, good order, cleanliness, labor, instruction, and ready and continual supervision should be maintained, within the limits of such fiscal economy as public opinion and resources rendered expedient. The earliest and most noted experiments were made at Horsham, Petworth, and Gloucester, in England; and in the old Walnut street gaol, at Philadelphia. The record of these attempts fortunately still remains; and it would be superfluous to discuss their want of adaptedness to any large scheme of separate discipline. The next remarkable effort was at Pittsburg, where a circular prison was erected, so ill suited to its objects, that in less than ten years after its completion, it was demolished. The next step of progress was the erection of the Eastern Penitentiary; and it must be obvious, that much was involved in the success or failure of its architect. There was not in all Europe a building suited to the objects of the contemplated work."

In April, 1853, his memorial to the Legislature in favor of a House of Correction, was adopted by the Society. About the same time he started the subject of relief for persons suffering from the hardships and oppressions occurring in the practice of the Criminal Courts in the City and County of Philadelphia. So much is now done by various agencies to diminish these particular evils and with such good results, that it is amazing the subject was not earlier broached. It shows how necessary to society, oftentimes, is the watchful, warm-hearted intelligence of a single person.

Early in the Summer of 1855 Mr. Foulke visited Harrisburg, and was astonished and grieved to find that the law of 1847 had

become virtually a dead letter, and he urged the establishment of a Penal Bureau, which, however, was never done. But he published that year under the auspices of the Society a pamphlet of fifty pages entitled, "Remarks on the Penal System of Pennsylvania, particularly with reference to County Prisons," accompanied with elevations and ground plans drawn by Haviland, the pamphlet being a careful recast of a rapid sketch which he, Mr. Foulke, had written for the Journal of the Society.* It is full of the marks of a mind used to taking large views and expressing them with a happy faculty. He took occasion in this pamphlet "to renew the serious appeal which it has been our duty," as he expresses it, "from time to time, to make in relation to the local jails of the State." He gives a history of some of the county jails, and of our Eastern Penitentiary, and argues in favor of its system of separation. He adds to this a description of the New York County Prison.

In February, 1858, Mr. Foulke first proposed the appointment of a Committee to revise the Penal Code of the State. His memorial, adopted by the Society, produced in due time the necessary legislation; and he was appointed by the Society on a committee to confer with the State Commissioners, and to suggest such changes of the Code, as the long experience and close observation of the Society, had taught it to think desirable. The Commissioners were appointed in 1859, and a report of the conferences appeared the following year.

In 1860 the report of the three Commissioners was submitted. Mr. Foulke soon after published, in a pamphlet of thirty-five pages, his "Considerations respecting the policy of some recent Legislation in Pennsylvania," the opening paragraph of which will very well illustrate the clearness of his thinking and the beauty of his style:—"The history of reforms of penal discipline resembles in many respects that of other attempts to remedy great social mischiefs. At first we have the disclosure of the main evil, to which the public eye and mind had become habituated, and the real magnitude, nature and causes of which were therefore slowly appreciated by the community at large. Then come the earnest efforts of a few well instructed and zealous reformers, whose laborious task it is to obtain the authority and means requisite for proposed changes. They define the mischief, trace its causes, indicate the departures to be made

* Reprinted by the Society in 1868.

from the old routine, and invent the machinery of the remedy which the government is to sanction, establish and conduct. During the first stage of such an undertaking, all minds are occupied with fundamental considerations; and it is only after the experiment has made progress through some steps of trial, that its details receive the special scrutiny which is indispensable to complete success."

He then takes up once more the old debate between separation and non-separation of Prisoners, and treats the subject of Punishments and Pardons upon the broadest ground. Starting from the acknowledged postulates that it is impossible to form a reliable judgment on the value of outward signs of penitence; that a strict observance of prison rules and discipline can never, by itself, be a fair criterion to enable us to judge how a prisoner will conduct himself after he has obtained his liberty; that suffering is an essential element to any useful prison discipline, on whatever general theory imprisonment takes place, he criticises the whole ground plan of the New Penal Code, and charges to it want of due consideration and consultation, and improper haste. With the legal arguments we have nothing here to do. Our object is only to show in which direction his benevolent intelligence exercised itself.

In the Autumn of 1860 he was appointed a delegate to the Convention of State Prison Wardens, &c. (first held at Philadelphia), adjourned to meet in the City of New York. At the Philadelphia meeting a citizen of Indiana had been appointed to prepare an essay in defence of the Associated or Congregate System of Prison Discipline; and Mr. Foulke to prepare an essay in defence of the Separate System. Three days the Convention sat, and resulted in the formation of a society, to meet for the first time in Baltimore in October, 1861. Mr. Foulke was made its Corresponding Secretary. The breaking out of the Rebellion prevented his ever acting in this capacity; but his essay was published in a pamphlet of 112 pages, and was entitled "Remarks on Cellular Separation, read by appointment of the American Association for the Improvement of Penal and Reformatory Institutions, at the Annual Meeting in New York, November 29, 1860." It is a most elaborately finished argument, vindicatory of the Pennsylvania system of Separate Imprisonment, the ripe result of his observations and reflections

on this his favorite topic, treating the subject exhaustively, with the acumen of a lawyer, and the just feeling of a true philanthropist.

In March, 1861, a committee, appointed the previous November, reported in favor of memorializing the Legislature for a law to reward the good behavior of convicts with a graduated diminution of their sentences. Mr. Foulke opposed this on legal grounds, and especially because the nonconcurrence of the Inspectors of the Eastern Penitentiary had been disregarded. Such a law was however obtained. The Inspectors courteously proposed to the Society an amicable suit to test its validity. A case was made, and the Court pronounced the law unconstitutional. In the initiation and pursuit of his philanthropic measures, Mr. Foulke was studiously careful never to put himself and his coadjutors into a false position, antagonising the statutes or authorities of government. If any change of law was contemplated, he exhibited a most scrupulous caution to avoid hasty and irregular means for reaching the desired end. Hence, in a great measure, his power and success in life. And hence his resignation from the Acting Committee of the Society, in October, 1861, actuated by an unconquerable repugnance to its assumed attitude of antagonism to the constituted authorities of the Eastern Penitentiary. His motives for this step, are lucidly and forcibly set forth in the last article of the last Volume of the Journal of Prison Discipline, — an article distinguished for its candor, and no less for the absence of all harsh dealing with the arguments of his opponents, — but so obnoxious to the friends of the new law, that an abrupt termination was put to the publication of the Journal. Resolutely opposed to whatever savored of bigotry in politics, religion, or social economy, while he patiently listened to all expressions of opposing opinions, he claimed a fair hearing in defence of his own. Thus ended that long career of active beneficence in this direction, of which all that has been said about it, is a poor and meagre sketch, doing no justice to the weeks and months and years devoted to journeys and examinations, consultations, discussions, conferences with strangers from other States and from European countries, correspondence, reports, addresses, memoirs, besides the constant active duties of inspection in Philadelphia, and attendance upon legislation at Harrisburg. The science of

social punishment and reformation he made his life study. It was not easy to suggest a practical inquiry that had not engaged his thoughts to answer. Persons, therefore, whose views extended no further than the actual condition of prisoners, and whose exertions were prompted mainly by sympathy with their sufferings, found it sometimes difficult to follow him into considerations also for the public welfare, based upon the necessary efficiency of a legislative and judicial government. His endeavor was to reconcile the highest interests of the Commonwealth with the utmost exhibition of humanity towards offenders. He had no sympathy for extremists, whether they took the side of severity or the side of lenity. Penal discipline being assumed needful, the only problem for him was to adapt it to the physical and moral nature of its subjects; that they should suffer no hardship not necessarily involved with the execution of the sentence of the judge, no diminution of health or intellect, and no further degradation of their character, but if possible its reinforcement, to meet temptation again when they reënter free society. These were the just demands of a Christian philanthropy. But beyond these first demands, he advocated as little interference as possible with the law and its official apparatus. This practical, judicious, moderate, candid, and yet earnest zeal, was in all other things, also, eminently characteristic of the man.*

The literary and scientific life of Mr. Foulke showed the same ardent temperament under complete control of an enlightened and disciplined judgment, the same breadth of views giving due value to the most insignificant details, the same elegant tastes inspired by a natural force of character which precluded pettiness and special pleading, and the same generous sympathy with the labors and progress of society, which distinguished the career of his philanthropy. He has left no name in politics, because he comprehended from too high a point of view the fundamental questions of the day and nation; for the same reason he left no name in science, because while he took a most unselfish and sympathetic interest in every investigation and discovery made by his friends at the Academy, he could not devote his time to any special branch of natural history. In spite of

* Many of the material facts narrated above and some of the expressions themselves, were furnished by the memoranda of the late Mr. Fred. W. Packard, of Philadelphia.

the occupations of an active business life, he was seldom absent from the regular meetings both in Broad street and in this Hall, and no man ever enjoyed more thoroughly, or gave himself up more vivaciously to the society of those who dealt exclusively in science. On the broad fishing banks of this sublime ocean of the unknown and marvelous, he seldom cast the line, but his hand was habituated to an equally important task — he was of those who knew well how to steer. No man need desire for himself a purer fame than that of an executive genius in the active world of science. To have been the principal agent in setting on foot and seeing safely off an Arctic expedition, is sufficient of itself to justify the self-satisfaction of any private citizen. In one of his letters to Prof. Bache, dated June 30th, 1860, he modestly alludes to the sailing of the Expedition as "the end of three years of serious and often perplexed effort."

But I am wrong in saying that he left no name in special science. His name is forever joined with one of the most remarkable discoveries in Palæontology, that of the huge Saurian of the Cretaceous rocks of New Jersey, the *Hadrosaurus Foulkei;* and to a new shell, the *Corbula Foulkei*, found in the same stratum. The history of this discovery is given in full in the Proceedings of the Academy of Natural Sciences of Philadelphia, under date of December 14th, 1858; and it need not here be repeated in detail. It illustrates however his capacity for that persevering and intelligent research, to which modern science owes its triumphs, too well to be passed over with a mere verbal allusion.

Mr. Foulke was living at a country house in Haddonfield, New Jersey, about six miles south-east from Philadelphia, in the summer and autumn of 1858. Hearing of fossil bones thrown out from the neighboring marl pits of Mr. Hopkins, twenty years before, and not succeeding in his attempt to recover them, he obtained permission to reopen the old pit to search for more. It was no easy matter to find the pit itself; and after it had been found, many trials must be made to identify the exact place where bones had been discovered. At last success crowned the undertaking. In the west wall of the pit, under eight feet of surface rock, lay a thin stratum of decomposed shells, and two feet beneath this another, in and on which

were found a pile of monstrous bones, enveloped in the tough, tenaceous, bluish marl, from which they were carefully extricated with a knife and trowel, drawings and measurements being made of each bone where it lay, to prevent embarrassment in the study. Wrapped in coarse cloth and straw, they were despatched to the Museum of the Academy, and are now while I address you, being mounted in the lower hall of the Museum, by the English geologist, Mr. Hawkins, and at his own expense.*

The animal specimen thus discovered is unique. No other like it† has ever been encountered, either in the New World or the Old, although hundreds of bones have been annually turned out from the marl pits of the Atlantic seaboard. Most of these bones, it is true, have been reburied, or destroyed, through ignorance of their scientific value; and there is no knowing how many skeletons of Hadrosaurus might have been secured. But as yet, this is the only one; and we owe its acquisition to the scientific cultivation of one, who was prevented from running a brilliant career in special science only by the philosophic scope of his whole life, and the obedience which he owed to other duties. The creature was an immense herbivorous saurian, with huge hind legs and very small arms, a veritable crocodilian kangaroo, as large as an elephant, and as tall as a giraffe. One of the highest living authorities, Professor Huxley, has just published his opinion that we have in this and other allied Dinosaurian forms a synthetic type between the reptiles and the birds. The Hadrosaurus may have been amphibious in its habits. Its long lacertian tail and the structure of its feet suggest aquatic

* Mr. Hawkins is well known for his admirable palæontological restorations in the grounds of the Sydenham Palace. He is at present working out, in the Museum of the Academy at Philadelphia, similar restorations of American extinct monsters, for the Central Park at New York. (Nov. 21, 1868. At the meeting of the members of the Academy called to-day to examine the finished mounting, and to listen to Mr. Hawkins' description of the parts, Dr. Leidy, in behalf of the Curators of the Academy, accepted the gift, returned thanks to Mr. Hawkins, and described the discovery of the bones. He gave great praise to Mr. Foulke for the resolution with which he pushed forward his researches, after having been advised that there was good reason for believing, that any bones discoverable would probably be those of mammoth, several skeletons of which had been found in marl pits in New Jersey. As the bones of Hadrosaurus which were found were those of the left side of the animal, on which it lay, it is probable that the lost bones, found twenty years previously, had been those of the right side, together with the missing vertebræ and skull.)

† Its nearest relative is the Iguanodon of the Weald & L. green sand deposits of Europe. (Leidy.)

habits; but when on shore it must have walked in a measure erect, like struthous birds, or have leaped like the batrachians. When feeding it must have made a tripod of its hind legs and tail, grasping with its short forelegs the branches, on the leaves or fruit of which it browsed, of some kind of evergreen; for all the specimens of wood found embedded with it proved, on microscopic examination, to be coniferous. How its carcass came to lie upon a bed of shells, interspersed with these chunks of wood, is hard to explain. The shells were of forty-two different species, and some of them so fragile and yet so uninjured, the most tender and delicate forms showing no trace of abrasion, and the two valves of all the bivalves being still together, that the water in which they lived must have been either perfectly protected from the winds, or else profoundly deep. The marl itself is sufficient evidence of the stoppage of all the currents carrying sand. We might therefore suppose a bog — or lagoon — or archipelago deposit. But this supposition is opposed by the great geographical extent of the Middle Cretaceous Formation, from New York to New Orleans and Cairo; and by the uniform composition of the mineral, and uniform thickness of the stratum.

It remains then to determine the limits of the ocean in which, and the direction of the muddy current by which it was deposited. The investigation of this question has never to my knowledge been undertaken. Instead of that, an undue degree of attention has been bestowed upon the question of mere age. Vanuxem, Morton, Rogers, Tuomey, Hall, Meek, Hayden, Marcou, Cooke, Lyell, D'Orbigny, Mantell, are all in turn cited by Mr. Lea, as expressing discordant opinions in attempting a correlation of the Green Sand marls of our side, with the Lower, Middle or Upper Green Sand of the other side of the Atlantic, by means of the imbedded forms of animal life. Now recent investigations into the Cretaceous and Tertiary Formations of the West, — investigations still continued on the largest scale, — teach us how little value is to be set on fossils, whether animal or vegetable, especially vegetable, as indicators of precise contemporaneity. They show how the principle of life has pursued its route of development through a normal series of forms, at different rates on distant continents, and in separate water basins; one region out-stripping another in the Darwinian race;

and anticipating it in the fresher analogons of the fading out life-forms. Questions then of the comparative chronology of strata in Europe and America by fossils, are of less importance than questions of structure and process and condition — questions not of the *when*, but of the *how* and *why*.

Where was the forest in which this strange creature browsed? What was the river down which his dead body floated? Where ran the shores of the sea in the marl of which he sank? Why were his bones not destroyed before the sediment could cover them? How high were the Germantown hills in that Cretaceous era? And what was the Gulf Stream doing? How far may the dip of the visible strata carry out the marl beneath the Atlantic seaboard? What has given this almost imperceptible and yet universal south-east inclination to all the Cretaceous and Tertiary Formations of the Tide Water border of our Continent? These, and other questions like them, are worthy of the sleepless thought of our geologists. But a prolonged discussion of whether the facies of the fauna of the Haddonfield marls is enough like the facies of the fauna of the Blackdown Greensand of Fitton, or the Cénomanien of D'Orbigny's enumeration, to establish the Synchronism of their deposition, seems almost puerile, as we know that every region has its different fauna at the present moment. Such questions may do to exercise the observations of young geologists and stimulate their classifications. But trained and experienced thinkers will busy themselves with far more difficult and delicate questions, until the settlement of which our science will continue to wear too much the semblance of a watchcase without the works. It was chiefly because of his interest in such questions, that Mr. Foulke never engaged in the determination of specific forms. His mind was philosophic in the largest and highest sense, and loved to deal with questions of the most comprehensive reach; while he felt all the importance of accuracy in details, and the genuineness of fundamental data. But he was especially inspired by the progress of Human Knowledge; and many an hour he spent discussing its steps and stages in the history of the past, its lines of movement now, and the indications of its future course.*

* Mr. Cope has recently made the important discovery of a fresh-water stratum of blue clay, apparently lower in position than the Hadrosaurus bed of Haddonfield. The new locality is six miles north-east of Camden, and ten miles north of the pit in which the Hadrosaurus was found (see Mr. Isaac Lea's

Among the earliest acts of the founders of the Academy of Natural Sciences of Philadelphia, was a resolution that its origin should date from the 21st day of March, A. D., 1812. The Anniversary of this day in 1854, was a marked occasion; because of the desire that the members felt to celebrate the erection of their New Hall. Members, Correspondents and their guests assembled at a sumptuous dinner in the Musical Fund Hall. On the evening previous a discourse was pronounced by Mr. Foulke before an audience assembled in the Hall of the

paper in the Proceedings of the Academy of Natural Sciences of Philadelphia, read June 9, 1868). Eight species of Unio and two species of Anodonta were found by Mr. Cope. Mr. Conrad refers the blue clay to an ancient water-course of the Delaware river, which there is some reason to believe crossed middle New Jersey in a direct line to the sea shore. If this blue clay be indeed above the Hadrosaurus Green Sands, then the remarks above, in the text, on the invalidity of fossil determinations of age between widely separated regions receive additional force; for the fresh-water Wealden, with its Iguanodon remains underlies the Green Sand of England. On the other hand, Messrs. Meek and Hayden have found extensive fresh-water deposits at the mouth of the Judith river in the Central basin of the North American Continent, and consider them as constituting the bottom subdivision (No. 1) of the Middle Cretaceous. Such deposits can hardly have relationships of time with one another as marine deposits have. They are the local phenomena of all ages. The Delaware river has flowed in about the same channel which it now occupies ever since the close of the New Red, Norristown, or Connecticut River Sand Stone era; a channel determined by the topographical features of the Baltimore-Philadelphia Lower Silurian (Quebec Group?) hills, on which Germantown, back of Philadelphia, is situated, and terminating in a promontory at Trenton. This range of hill land must have been higher in the air before the close of the New Red era than now, because it has suffered immense erosion since then. But apart from that consideration, it must have been carried bodily upward to a still higher general level, by that rise of the Continent, which not only dried the New Red estuary basin, but elevated the New Red sediments many hundred feet, forming the Pennsylvania and New Jersey New Red hill country of the present day. But this elevation could not have been effected without the production either of hill country, low plains, or submarine shallows all along the area now occupied by Southern New Jersey, Delaware, &c. The River Delaware may at that time have had a much longer course, but in what direction, would be determined by the nature of the uplifted land. It may have meandered through vast marshes, like those of the Carolina sea board; or it may even have flowed far away toward the southwest into the Susquehannah river, itself prolonged. In this river channel would have been deposited the fresh-water blue clay with Mr. Cope's Unionidæ. Subsequently, a reversed or downward movement shortened the river, submerged the outside land, produced an archipelago along the coast and permitted the deposit of the Cretaceous and Tertiary formations, which, by a final reëlevation, have now become Southern New Jersey, Delaware, Eastern Virginia, &c. But the more recent discovery of the bones of a postpleiocene horse, by Prof. Cope, in such relations to this clay bed, as to make it pretty certain that the animal was embedded in it, near its lower limit, relieves us from the necessity of considering the deposit older than the Hadrosaurus marl.

University of Pennsylvania. This address was afterwards published for the Academy. It recounts the progress of the Academy from its beginning, when, in the shop of an apothecary, at the north-east corner of Market and Second streets, John Speakman called about him the intelligent scholars and amateur naturalists which Philadelphia already then possessed, making his shop a centre of literary and scientific gossip, and then with Jacob Gilliams, Troost, McMahon, Mann, John Shinn and Parmentier, organized regular meetings in Mercer's Cake Shop near the corner of Market street and Franklin place. He described the *growth* of the Museum, from the time of its removal to the corner of Twelfth and George streets, 1828, until it filled with its treasures the rooms it occupies now to overflowing.

An apology for such an institution follows naturally in the course of his address. It was not an uncalled for display of eloquence. The fine sciences and fine arts cannot flourish in the open air of a democratic commonwealth. They need the hot house culture which the concentrated power of an autocracy, or the exclusive privileges of an oligarchy, alone seem competent to afford. The splendid monuments of Egypt and India rose at the bidding of tyrants, invested with priestly omnipotence. The glories of Athens and of Rome appeared at sunset of their republican liberties. The learning of Islam was the culture of the Caliphs. Norman and Gothic architecture was imported from the Orient at the close of Crusades, which destroyed the peerage of feudalism, and constituted empires from its ruins. The commerce of Genoa and Venice manured the ground, but the Dorias, Viscontis and Medicis, planted and reaped the first crops of that art and that learning which we now enjoy. The Paris of to-day is a monument of irresponsible power in the hands of a man. The London of to-day is a monument of irresponsible power in the hands of a class. But the Philadelphia of to-day builds no monuments. It builds private stores, private churches, and private mansions. Its great lack is an absence of centralization. Its democratic polity is that of an army without head quarters. Ill natured criticism would have too much reason if it said that it belonged in the division of the Articulata. Its intellect and taste, like scattered brands, cannot blaze and spread into a general flame. Our citizenship plumes itself, not on realizing

great ideas of public good and beauty, but on the universal distribution of loaves and fishes to the multitude. A cynical herald might escape punishment who gave for its blazon a dragon Argent, couchant, on a field Or, drinking champagne from an oyster shell, and holding aloft a liberty cap upon the end of its tail.

Philadelphia was once governed by an aristocracy of intellect and taste. But our Wistar party is no more. Our Chinese Museum is burnt down. Our Museum of Natural History is perishing for want of a few thousands to pay for its proper care. Our Philosophical Society owns scarcely a single book that represents the advanced intelligence of the present generation, and the few that it possesses are acknowledged in its proceedings as *donations*.

Is there not an explanation of all this at hand? Are not private luxury and public spirit inconvertible forces of nature, — mutually destructive. The associative interests of a democracy produce a uniform balance of rights, and a uniform mediocrity of character; while the personal pride of an aristocrat compels him to shine as a public benefactor. While vulgar men grasp political power to convert it to the base uses of the present hour, men of rank in family, intellect, and taste, regard the future, and love the grand: *Noblesse oblige*.

Mr. Foulke did not, indeed, say these things in his anniversary address, when he urged the utility of preserving and enlarging the Museum of the Academy of Natural History, for the well-being of the population of his native city. But in private conversation, no one lamented more that general lack of appreciation for the more spiritual adornments of a commonwealth which is manifested by even those who devote themselves most zealously to schemes for increasing the material wealth and comfort of the community.

In this discourse he exclaims: "Do you not desire to become participators in some way with those who are hereafter to strengthen and enlarge the resources of such an institution and to apply them to the general good? As men you have the common interest of the species in whatever can augment and vary the instruments of civilization. . . . . Surrounded by luxuries, secure in the enjoyments of home, or engaged in the cheerful commerce of society, have you no offering to make to the treasury of this temple? . . . You have children, who may be taught

the value and the dignity of its relationships to human progress. Consider how your obligations are strengthened by circumstances peculiar to the age in which you live, or to your own country. . . . Let men of science be assured that you appreciate what they are doing and suffering. . . . The days of fire and faggot have indeed passed away, . . . yet the roll of the martyrs of science was not ended with those who suffered by the dungeon or the stake. . . . It is hazarding nothing to say that an important novelty in science, however clearly and firmly attested, might be received as unwillingly and contested as hotly, and might make as wide breaches of social connections, as could be asserted of the modern systems of astronomy and geology at the time of their first promulgation. . . . It is over the newly-made grave of Morton that science once more appeals to mankind to cease from outraging the name of Religion by persecutions of those who honestly seek to read aright the works of the Master of Life."

As may be judged by these dislocated fragments of discourse, Mr. Foulke was an ardent champion for freedom of scientific and religious opinion. His zeal in this quarter led him to the publication of a pamphlet, in 1857, entitled "Notice of Some Remarks by the late Mr. Hugh Miller, &c.," being certain passages on pages 159, 160, 161 of the first American edition (1854) of Mr. Miller's Lecture on the Two Records, Mosaic and Geological, and other passages on pages 171 to 175. These passages were cited by Mr. Foulke at a meeting of the Academy (May 9, 1854), in a kind and most respectful manner, merely with the design to guard against such unwarranted generalizations of science as Mr. Miller allowed himself for theological purposes. His remarks bore upon the importance of maintaining scrutiny of the logic of the natural sciences, especially now, during a prevailing disposition to "reconcile" the results of scientific researches, by extreme processes, with the popular interpretation of certain texts of the Mosaic history.

In the next American edition of the Two Records, published shortly before Mr. Miller's death, notes to these pages appeared, charging Mr. Foulke with downright unfairness, and speaking scornfully of his connection with a learned society. In order to correct such complete misapprehension of the motive and drift of his criticism, Mr. Foulke replied at the meeting of the Acad-

emy, May 5, 1857, giving all due credit and respect to so distinguished an opponent, but reiterating and re-enforcing his arguments, and rebutting the charges made against himself. Soon after the appearance of the notice in the Proceedings of the Academy, Mr. Davies, a Scottish clergyman, addressed a letter to Mr. Foulke, expressing hearty concurrence with his view of the value of Mr. Miller's reasoning.

Another episode in Mr. Foulke's life was produced by the tantalizing circumstances connected with the suspension of the Reports of the Geological Survey of Pennsylvania. The field work, which had occupied seven years, ceasing in the fall of 1840, the materials for illustrating the final Report were placed by Professor Rogers in my hands; and in 1842 I had completed the State Map, the Geological Sections across the State, and drawn or redrawn for the wood-cutter all the diagrams which afterwards were published in the two quarto volumes of the Final Report. Then my connection with the survey ceased. Mr. Rogers moved his residence to Boston. There was a dead-lock between him and the State authorities at Harrisburg. They held the treasury and he kept the manuscripts.

At the beginning of the winter of 1846, '47, he wrote to me to come to him in Boston. A demand for the MSS. had been made which he could not resist, and he wished me to duplicate the whole, which I did: the Map of the State, the long sections, and all the illustrations of the text, with parts of the text itself. This copy was sent to Harrisburg. There it lay, without finding an editor, until the winter of 1850, '51, forgotten or despised. Some said it was useless; others, that it would be used too well by designing men. Some accused it of tedious verbiage; others, of culpable incompleteness. Some alleged that the surface of Pennsylvania was still too unsettled to make a truthful survey possible; others, that the progress of mining and railroad surveying had left the assertions of the report behind them among disproved and exploded things. There were hardly a dozen men in the whole Commonwealth who knew either the character of the Report or the actual value of the Survey. Among these Mr. Foulke occupied perhaps the most prominent position; and he it was who finally succeeded in dragging up the buried manuscript into public notice, and in stimulating sufficiently public opinion in its favor to get an act passed for its publication. The

fight was stubborn. Mr. Rogers, being advised to remain at a distance and abide the result, did not appear in the transaction. The cry was raised, Let us have the Final Report, whatever it is, and have done with it! let us see what we have paid a hundred thousand dollars for, at all events.

On the 12th of April, 1851, a resolution passed the Legislature by a vote of 49 to 42, appropriating $32,000 to the revision and publication of the Final Report of the survey. Excepting one or two who were entrusted with the secret, the members were unaware that additional surveying was in question. Mr. Rogers however, immediately took the field, assisted by Mr. Sheafer, Mr. Desor, Mr. Lesquereux, and myself. Mr. Sheafer brought to the work his long experience and thorough acquaintance with the underground of the anthracite region. Mr. Lesquereux perfected his system for identifying the different coal-beds by their vegetable fossils. Mr. Desor applied his Alpine studies to the local drift, the outcrop marks of the region to be studied. I undertook the task of mapping on a large scale, and representing in light and shade the surface aspects, the outcrop terraces, the sandstone ribbing of the gaps, the varied erosion of the crests, and the relationship which the opened gangways bore to these. The Southern Basin, from ten miles east of Pottsville to twenty miles west of it, was cross-barred in parallel lines, one or two thousand feet apart, running from the crest of the Sharp Mountain, about N. 25° W. to the crest of the Broad Mountain, and in some cases to the summit overlooking the valley of the Mahanoy. These lines, measured, levelled, and staked, were tied together by transverse staked and levelled lines, one set running along the hill tops, another along the valley bottoms. To this system all the railroad surveys were tied; the branch roads, gangways, trial and air shafts were located properly; and in a few indispensible cases, where beds had not been opened, new trial shafts were made.

Six months passed thus, every working moment occupied. The map advanced as the surveying furnished the material. Still, quite as much remained undone. Another year was wanting to complete the first and second basins, to say nothing of the third. But Mr. Rogers could not keep his corps together. The following spring he employed a land surveyor (Mr. Poole) to complete the map as far as Mauch Chunk, and joined with him a

worthy geologist, Mr. Dalsen. These gentlemen reduced my large sheet maps to one on a very small scale, which was some years afterwards published as part of the Atlas of the Final Report.

The sheets of the great map have never seen the light. They are probably in Mr. Rogers' portfolios. He once informed me that he considered them the only perquisite attached to his office as chief of the survey. The loss is perhaps now irreparable. They became private property by a subsequent act of Legislature. For the act of 1851 seemed to bring the publication of the Final Report no nearer to a pass than ever. And it was not until an arrangement was made, by which Mr. Rogers should obtain personal propriety of all the records, maps, pictures, and characteristic fossils of the survey, for the consideration of one thousand copies delivered to the Legislature, that the book appeared. And this was not until 1859, when the publication was made by a firm in Edinburgh.

Mr. Foulke's interest in the Survey was of a purely scientific and philanthropic character. In February, 1851, he wrote to Mr. G. H. Hart, a member of the House: "You are aware that I have no connection with nor interest in such a subject, except what is common to all my fellow citizens — that in my journeys through many of our counties (probably more than two-thirds of them), and in conversation with experienced persons, and in my reading of essays and reports of scientific men and other ways, I have received illustrations more numerous than those to which other citizens have general access; and that the convictions thus fastened upon me are the reasons for my intervention in this business." He wrote to Mr. Rogers, the same month: "It is proper to say to you that any part which I take respecting the publication of the final report upon the geology of Pennsylvania is prompted exclusively by my opinion of the value of that report; by a regard to the position occupied by the State government, and by a sense of justice in relation to yourself. It will therefore be unnecessary to include me in any pecuniary arrangement which it may appear to you expedient to make for the purpose of forwarding the publication."

And it was in this spirit that all his acts having reference to public affairs were performed.

Another instance of his active interest in things affecting the general good, is afforded by the history of the erection of the Academy of Music, or Opera House, at the corner of Broad and Locust streets. "I am not of the number of those (he wrote to a friend, under date of April 3d, 1852,) who think that the shortness of life is a reason for despising or avoiding its enjoyments, but it *is* a reason for maintaining a proportion and subordination of our activities, and for selecting the objects of these according to a standard of choice which accords with the highest laws of conduct known to our race." There remain among his private papers "more than 120 memoranda, drafts of speeches, letters, notes, &c., in his handwriting, having reference to the project. He was one of three who set the enterprise on foot, and he promptly took practical measures with regard to it. The earliest decisive movement towards it was in 1852, when [March 4th, 1852] an Act to incorporate the 'American Academy of Music' was passed. A supplement to this act of incorporation was drafted in the following April, by Mr. Foulke, and was taken by Mr. A. H. Smith, to Harrisburg. Owing to the financial condition of our country the project lay dormant for a year. In April, 1853, Mr. Foulke set about stirring up in its favour the interest of influential persons. He advocated the undertaking for a variety of reasons. He held that 'to lay the foundation of such a system would enable us hereafter to command the best musical talent of the world, and would enable us to provide for the cultivation of such talent among ourselves.' Contemplating the use of the Opera House for representation also of the drama, he desired to see brought about the purification of the taste and manners of the masses, by elevating the standard of popular amusements of this sort."

His views respecting the proper method of attaining this desirable end were peculiar to the generous scope of his own mind, and illustrate his character well. He contended for a music house for the people at large; not to be one of the exclusive luxuries of the fashionable and wealthy; a house to contain four or five thousand persons, admitted at low rates; an institution to excite general popularity; able to cultivate a universal taste for the best music, and obtaining thus every year a surer guaranty for its usefulness; "providing" as he said, "by liberality of design for the future enlargement of our musi-

cal and dramatic resources, regard being had to the rapid growth of our population and wealth." He designed as part of the plan, a liberal support for the minor perfomers, so that they might be, or become, permanent residents of the city, and thus prevent the Opera House from falling into the hands of foreign managers of troupes, whose expenses would necessarily raise the price of tickets to a figure that must practically exclude the people. But he was overruled; and the erection of an Academy of Music has done comparatively little for popularising the best music of the old world among the common people of our city. Whereas, the effects of its central influence should already have been seen in an improvement in musical culture in every county of the State; just as the influence of the Loyal Union League has improved the political knowledge, sentiment and zeal of the whole commonwealth.

The quality of Mr. Foulke's mind may be measured, perhaps, as well by his Essay on the Right Use of History, as by any other memorial of his life. He had been one, with Mr. Joseph R. Ingersoll, the Rev. Albert Barnes, and Bishop Potter, appointed to deliver addresses before the Pennsylvania Historical Society, in December, 1850. His address was published, with others, in 1856. It shows his disposition to take the most comprehensive view of every subject coming under his attention. He chose for his theme the practical advantage of a study of history for the young, and the best method of reaping that advantage. Granting the value of special research, he urged that more was necessary than "merely to gather, with the minute diligence of the typical antiquary, relics of the former time; to trace partially defaced inscriptions; to perpetuate images of decaying edifices, or the details of obsolete wardrobes. Whatever the associations which invest these with a value, or bind them to us by ties of a personal interest, they are comparatively trivial incidents to our pursuits. Even the events which are most widely known, and the men who shine most conspicuously among the great actors of the past, have a limited historical value; the extent of which is determined by their contributions to moral results. It is to the definition of these results, and their communication to our fellow men, that our associate efforts should tend." He showed how "the influence of history even upon adults is subject to grave qualifications, since some of its examples are available only in an

imperfect manner, even as guides to the understanding; for the shifting of circumstances renders it often difficult, and in some cases impossible, to establish for ourselves a certain theory of cause and effect. The conduct of men depends not upon detached facts or doctrines merely remembered, whether they have been learned early or late in life; but upon habits of thought and feeling; upon the association of ideas with the impulses which directly prompt to action. No school instruction can do more than establish such associations; none can perfect the knowledge, nor unalterably fix the habits of pupils. Hence, *the selection of the ends of conduct, the adjustment of the relative rank of principles; the establishment of certain habitual criteria; and the promoting of that development and orderly exercise of each faculty, which result from judicious discipline*—unless we purpose amusement or display, these must be the objects of instruction in history."

In my own personal intercourse with Mr. Foulke, which was frequent and intimate, I was profoundly impressed by one characteristic of his mind, more than by almost any other; namely, a hopelessness respecting the attainment of definite knowledge. This hopelessness was the result of two facts in his experience; first, that by reading diligently in almost every department of human science, he had attained an intellectual point of view, from which the boundlessness of nature and history and human life could be descried; and secondly, in devoting special zeal to special investigations, he had learned that the most judicious could seldom decide with confidence the absolute truth or the abstract right in anything. Among all my acquaintances I had no other whose spirit echoed so to the letter the despair of the wise man of Palestine, that the search after knowledge would ever be anything else than vanity and vexation of spirit. Inspired by this sentiment, he urges in this address, that "we should in vain attempt to teach all history," quoting his favorite, Dr. Arnold, who, after rising to the first rank of philosophical historians, could say "of many large and fruitful districts in the vast territory of modern history I possess only the most superficial knowledge; of some I am all but totally ignorant;" and Robertson: "the collections of historical materials are so vast, the term of human life is too short for the study or even the perusal of them. What then can be done during the longest academic period?"

His conclusion is that the details of history must be taught in the most abject subordination to its principles. The memorizing of dates must give way before the inculcation of ethical doctrines. The heart beats with a time of its own, not measured by the stars. The commencement of the Christian era itself is undetermined. His scheme of school instruction, then, at least for the mass of learners in American schools, limited itself to the inculcation of "*select practical precepts, illustrated by historical examples, and enforced by the aids used for the development of personal character.*"

In illustration of this scheme, I am tempted to quote page after page of this elegant and forcible address, but neither time permits, nor is more needful to show how naturally he generalized always in a practically philanthropic direction. He would conduct school discipline as he would guide prison discipline, out of the Egypt of empiricism into the promised land of life-inspiring philosophy. The schoolmaster as well as the jailor must be a philanthropist: the one must treat his prisoner and the other his scholar with an eye to make him a worthy citizen of the Republic. Therefore, in teaching history, facts are to be grouped about principles and doctrines, and to be remembered only when these principles and doctrines are to be applied. And his arguments were, that thus history can be taught with equal success to all classes of learners; the instruction can be made permanent in the mind and life; the great events of the past can be made to produce their greatest effect upon sentiments while plastic in the spring-time of life; a sentiment for civil obedience will grow along with the sentiment of domestic duty; and the love of progress can be harmoniously linked with a rational adherence to a settled order of things. The struggle of ages between the partisans of change and the adherents of established order,—the excesses of demand and of resistance,—the action of a majority prompted more by particular evils alleged or felt than by any consistent general estimate of the effects of existing institutions,—and the acrimonious character of political partisanship, will become evils of the past.

I have used his own expressions, scattered over the pages of this address. But I would not give the impression that he held Utopian views. Far from it. The only hope of the future which he cherished was of the largest and longest term. His political

motto was "*the fraternity of the race.*" He did not believe in republicanism as the only and sufficient panacea for the woes of society. "When we read," he says, — "when we read of mobs of the ancient world, who broke open senators' houses, and piled and fired their furniture in the forum; who took forcible possession of the *rostra*, and who disturbed or suspended the *comitia* by outcry or violence; who even pressed upon the senate so that the knights and others guarded the deliberations with drawn swords; who fired temples erected by obnoxious citizens, and who nullified legislative decrees constitutionally enacted,—we might attribute these disorders to the impatience of oppressed subjects, or to the licentiousness of mercenary adherents of profligate men striving for power and for the control of the public treasury. But when we turn to this republic, so wisely organized, so liberal in its institutions, so jealously restricted in favor of popular rights, so rich in the means of physical prosperity,—this Republic, in which no man attains to power except upon the uncontrolled votes of free electors; and even here, behold the same riotous excesses, the same armed intrusions upon the elective franchise; ballot-boxes forcibly broken open, and plundered, or abstracted, or fraudulently filled with spurious votes; contests with bludgeons and more deadly weapons; our citizens slaughtering each other in the open streets, and lighting the darkness of night by the flames of churches fired by their incendiary torches; and finally, when we see that these outrages, which charity might have attributed to a passing phrensy, are succeeded by deliberate attempts to nullify the laws of the land, —surely we have reason to look further than the subjects of controversy to discover the true sources of political mischiefs so dangerous to the commonwealth. Where can we find these, if not in those germs of individual character for the proper culture of which we design our methods of education?"*

* The allusions in this passage are, probably, to the bloodshed and burnings at Philadelphia, in the so called "Catholic Riots" of 1844; but they bear as pertinent an application to the elections of 1868. Mr. Foulke was then a young man. He immediately offered his services, in company with two of his young friends, Mr. Aubrey H. Smith and Mr. J. I. Clark Hare, to Mayor Scott, who appointed them his aids. They proposed the raising of a company to be composed of respectable young men. Lieut. Izard, of the Navy, was made Captain. It was stationed, on Thursday night, to guard St. Patrick's Church, and on the following night, at the College of St. Charles Borromeo, where many amusing episodes took place between the young men — the guards and the guarded. What

His cure for these evils of the society of all ages was no mechanical arrangement of the social machinery, no paper constitution, ballot box, or national flag; but a profound inoculation of each rising generation with the genius of Christian order, sympathy with justice and truth, and faith in the great dogma of the nineteenth century, the brotherhood of man. He predicted that "this idea of *the fraternity of the race*, so interesting in moral history, so fundamental to all rational theories of social connection and intercourse, is now approaching the place which it is ultimately to hold in the councils of nations, as well as in the minor arrangements of civil communities. "Teach this to our youth, if all else be unlearned. It is of incalculably greater worth than all the skeleton histories ever compiled."

Our friend was a true American. He loved his country and his own State, but in a large and generous way, and with many-sided sympathies for other races and peoples whom he never even saw. I remember well a curious illustration of this many-sidedness, which took place in his own dining room. Four men sat around the breakfast table. One, was an old school abolitionist, the personal friend of William Lloyd Garrison and Wendell Phillips; another, was a distinguished rabbi of the Jewish synagogue, with intense pro-slavery predilections; the third was a black man, a graduate of Oxford, and president of the Theological Seminary at Liberia; and the fourth, was the host. A party incongruous enough. Few men would be capable of fusing together such odd elements. But he could do it. And that without the sacrifice of either dignity or principle. Holding his own position firmly, he could estimate the worth of the most opposite characters, and draw from every kind of soil its own peculiar fruits. There was in him such a combination of religious faith with clear-sighted skepticism, — such a love of the good old ways, mixed with a zeal for better things to come, — such com-

threatened to be a national calamity, but was in fact only a salutary exercise of brute force by society, in its irresponsible state, determined at all hazards to suppress a chronic nuisance, — ended, when the desired object was attained, in a sudden and spontaneous return to the ordinary state of things. The good effects of this terrible outbreak of popular indignation against the great and otherwise intangible element of political disturbance in Philadelphia were felt for many years. But the appearance and bearing of our military volunteers may have preserved the city from secondary evils consequent upon the loosening of the ordinary restraints of the law upon the viler part of its population.

prehension of the springs of prejudice, with such reverence for whatever was true and noble in the lives and hearts of the most prejudiced — that he could be the adviser and the friend of all.

In politics, he said himself, that he was a Federalist. "Read the Federalist, and you will learn what I think." At a dinner given by the Maryland Historical Society, at Baltimore, in February, 1853, he had occasion to reply to some violent and inflammatory political remarks which fell from Senator Toombs of Georgia, who was one of the guests. Mr. Crittenden, who was also present, coming round the table to where Mr. Foulke was sitting, said that he wished to introduce himself to a gentleman who had reproved treasonable sentiments in so patriotic and forcible, and yet so controlled a manner. To the day of his death his treatment of those whom he considered the enemies of the Republic, was marked by a mixture of fearless sincerity and gentlemanly courtesy. In the vehemence of his feelings I never heard him use a harsh or ill-bred expression. A more loving, affectionate heart never beat. He was the tenderest of husbands and fathers.

It is not for me to enter more deeply into his inner life. He always expressed respect for the established forms of worship, while professing his entire independence of established creeds. The same moderation which characterized his mental estimate of the ultimate value of scientific attainments, those made by even the best thinkers, in view of the infinite copiousness, complexity and obscurity of the facts of the material world, equally characterized his estimate of the absolute finality of theological opinions based upon a discussion of invisible and spiritual things, the final causes of the universe, and the eschatology of schoolmen. He seemed to hold fast only by the moral principles of Christanity, the evident wisdom and goodness of God, the perfect adaptation of the Christian Gospel to remedy the evils and guide the upward progress of human life, the beauty of personal virtue, and the harmonious concurrence of reason and religion.

To this essential religious side of his character fitted his æsthetic sentiment, a keen appreciation of the beauties of nature, and a pure taste in high art. His private letters from the romantic scenes of our Pennsylvania mountain country breathe

not only the most healthy enjoyment of every object in nature, but that power of a cultivated imagination which transforms objects of sensible perception into symbols of thought and feeling. In times of trouble and personal sorrow he drew consolation and acquired new fortitude from the mute phantasmagoria of the earth and air; that pantomimic drama, where every scene infolds some esoteric mystery, only to be interpreted by those who have passed through the initiations.

His remarkable powers of conversation are known to all his acquaintances. He seemed to have read every book, to have known personally every representative man of the day, to have traveled through all the regions of modern knowledge. He narrated, and he argued, with equal perspicacity of view, purity of language, precision of details, and fulness of illustration; and perhaps no better conclusion to this slight sketch of his life and character can be made than by quoting what one of the most distinguished and one of the most temperately judicious of his fellow members in this Society said of him, after his death: "In all the world I have never met any one having the same extent and variety of knowledge, who had at the same time such accuracy and precision of knowledge."

Time enough has elapsed to enable us to estimate and lament his loss to us in this Hall; for he was preëminently one of those who kept alive the spirit of this Society; relieving our meetings of that stiffness and barrenness, which it always proves so difficult a task to remedy, where a few only assemble, periodically, not to relate their personal experimental discoveries, but to listen to the more general conclusions of philosophic thought. Nothing but the leading intelligence of a vivacious, enthusiastic, fearless, general scholar can save such meetings from degenerating into a dry observance of parliamentary forms, oppressed by the ennui of a constrained, cold silence, or the still less endurable ennui of a pseudo-scientific gossip in which everything is crudely said or timorously hinted at. It is not too much to affirm that the new life which this Society has begun to exhibit, is greatly due to the cultivated mental activity, the eloquent speech, the administrative ability, and the enthusiastic interest in everything occurring within these walls, ceaselessly exhibited by William Parker Foulke.

Stated Meeting, November 20th, 1868.

Present, fourteen members.

Prof. JOHN C. CRESSON, Vice-President, in the Chair.

A letter of envoi was received from Mr. A. Erdmann, dated Stockholm, June 15th, 1868.

Donations for the Library were received from M. A. Erdmann, the Prussian Academy, M. Carlier of Paris, the Boston Natural History Society, Mr. Hubbard, Dr. J. Wyman, the Journal of Science, Yale College, the Franklin Institute, Dr. J. A. Meigs, Dr. Emerson, Mr. J. Lea, Mr. Fr. Fraley, Mr. Joseph Lesley, and Mr. Shunk.

Dr. Wood spoke of the origin of earthquakes; and suggested as a possible producing cause, the expansive force of the fluid interior, on the supposition of a rigid crust, slowly increasing by solidification, the expansion being due to crystallisation.

Mr. Chase reported his observations of the meteors of the 14th inst.

Mr. Lesley read an English translation of Dr. Brugsch's German translation of the D'Orbiney Papyrus, and explained its mythological character.

The Minutes of the Board of Officers and Members in Council were read.

Nominations 593 and 594, and new nominations 595 to 619 were read.

Mr. Fraley, on the part of the Michaux Legacy Committee reported progress.

And the Society was adjourned.

Stated Meeting, December 4, 1868.

Present, twenty members.

Dr. G. B. Wood, President, in the Chair.

A letter requesting exchanges was received from Mr. Robert H. Scott, Director of the Meteorological Office of the Royal Society, 2 Parliament street, London, Nov. 10, 1868.

On motion, the Secretaries were directed to place the Meteorological Office on the list of corresponding societies, to receive the Proceedings.

A letter was received from Prof. Daniel Kirkwood, of the Indiana State University, Bloomington, Nov. 16, communicating his observations of the meteoric shower of the night of the 13th and 14th ultimo.

Donations were received for the Library from Dr. Schinz of Strasbourg, Herr Wetli of Zurich, the Society at Emden, M. Maisonneuve, and the Geographical Society of Paris, the London Meteorological Office, Mr. Hyatt of Cambridge, Mr. Hager of Montpelier, Mr. Steiger of New York, Mr. Challen of Philadelphia, the Medical News, Union League, Smithsonian Institution, War Department and National Academy.

Judge Sharswood read an obituary notice of Mr. Joseph R. Ingersoll.

The Committee to which Prof. Cope's Memoir for the Transactions had been recommitted, reported in favor of its publication, and it was then, on motion, referred to the Committee on Publication with power to act.

The Annual Report of the Treasurer was read.

The Annual statement of the Trustees of the Building Fund was read by Mr. Marsh.

The Annual Report of the Publication Committee was read.

Nominations Nos. 593 to 619 were read.

OBITUARY NOTICE OF JOSEPH REED INGERSOLL.

Read before the American Philosophical Society,

By George Sharswood.

The object of the American Philosophical Society in providing that wherever practicable, an Obituary Notice shall be prepared of deceased members, was not, as in some institutions abroad, to have an elaborate eulogy delivered. It was rather a brief memoir recording the principal events and literary or scientific works of their associate. The writer of this feels bound to confine himself within these limits, and therefore will not undertake to sketch the character or dwell upon the many marked excellencies of the member, in regard to whom the Society has assigned to him this sad but grateful duty.

Joseph Reed Ingersoll, the third son of Jared and Elizabeth Ingersoll, was born on the fourteenth day of June, 1786, in the City of Philadelphia.

Of his father, nothing need be here said. He was the son of an eminent lawyer, afterwards an Admiralty Judge of Pennsylvania under the colonial system. He was himself, perhaps, the most distinguished of the leaders of the Philadelphia Bar in its palmiest days. His life and character have been given to the public, in a spirited sketch, by a master hand. Jared Ingersoll was an honored member of this Society, having been elected January 19, 1781—eight years before he took his seat in the Federal Convention, that illustrious assembly over which George Washington presided, and which framed the Constitution of the United States. The early school days of the subject of this notice were passed in the city of his birth, under, no doubt, the best teachers in every department which it could then afford. He entered the College of New Jersey, at Princeton, in the year 1800, and graduated with the highest honors of his class in 1804. In this class, in which he bore away the palm of scholarship, were many men who afterwards attained high public eminence. He was a most earnest and indefatigable student, ambitious from the first, of that distinction which he succeeded in winning, and he used to mention as no small incentive to his application and industry during the period of his collegiate course, that almost every letter which he received from his father, wound up with the words, "Remember the honors."

He immediately commenced the study of the law in the office of his father, then in the height of his honorable professional career, and after the usual clerkship of three years, was admitted to the bar June 2, 1807. He soon found himself in a large and lucrative practice. I have not been able to find his first docket, but in one commencing with December, 1813, little more than six years after his admission, the average number of cases brought by him in the District Court and the Court of Common Pleas of this county, was upwards of fifty to each term, and to this must be added a very considerable practice in the Supreme Court of the State, and in the Federal Courts of this District. His first reported case among the decisions of the Supreme Court of Pennsylvania, was *Welsh admr. of Edwards* v. *Dusar*, 3 Binney, 329, which he argued for the defendant in 1811. His first reported case in the Supreme Court of the United States, was *Fitzsimmons, et. al.*, v. *Ogden, et. al.*, 7 Cranch, 2, in 1812, for the complainants. It would be an interesting task to trace in detail the history of his professional career, but it would be out of place. Few men at the bar of Philadelphia ever enjoyed so varied as well as so important a line of practice. His reputation for faithful attention to the business entrusted to him—his popular manners and pleasing address—his readiness and eloquence—combined to secure him numerous and valuable clients. That he was able to attend to it all, and do it so well, he owed to his methodical industry. He appeared never to flag, though his bodily and intellectual powers were taxed to the utmost. His favorite exercise was a ride on horseback—usually before breakfast in the morning. During all this busiest period of his life he was a close and systematic student—reading every new law book of any note which came out—and not confining himself to his professional reading, but extending it to general literature and science. There were no domains of knowledge, interesting or useful, which he does not appear to have explored. He prepared all his cases thoroughly—not only by research into authority—but by making himself acquainted with whatever subjects were incidental and auxiliary. Thus he seemed equally at home in questions of Medical Jurisprudence, on Mechanics and Chemistry in Patent cases, and on general matters of Geography and Commerce. He tried to master every case, and with industry and perseverance, united with his naturally quick perception, he

seemed never to fail. He early adopted the practice of making notes and extracts from the books he read, evidently not for the ordinary uses of a common place book, but rather as a mode of understanding and impressing them on his memory. He seems to have continued this practice, though no doubt with many interruptions, through his whole life. The books are without date, but there was a constant change going on in his hand writing, though the general character of it remained, which enables one to say with tolerable accuracy to what period any particular extract belongs. Among his manuscripts, and probably at a late period of his life, are to be found copies of many parts of the Holy Scriptures—a copy of the Book of Genesis, of Job, and considerable part of the Gospels. He kept, during the whole of his professional life, a diary, not indeed of all the cases and business brought to him, for that would have been impossible, but of such as seemed most interesting and important, and of which he wished to preserve a memorandum to refresh his memory. This diary is occasionally interrupted, though very rarely, with incidents of personal history. I say very rarely: I consider it very remarkable that so little is to be found in his library and manuscripts which relate to his own personal history. Even the orations and addresses which he was called on from time to time to deliver, and which were printed, were not preserved by him in any separate form. Yet I may be permitted here to draw from his diary two exceptional cases.

"March 9, 1827.—Returned from Washington, where I had gone on the 25th of February to argue *Pennock* v. *Dialogue*, and *Comegys* v. *Vasse*. Neither case, however, was reached. The *sojourn* there of a week was unprofitable, except that it showed how far from laboriously cases were generally argued there. Gentlemen who have acquired a reputation live on it sometimes without much effort to retain it. Political life seems to gratify those who are in the midst of it, as any ardent exertion of the mind, perhaps, will do, but to the looker on it is a heartless, comfortless, and I fear in many instances an unprincipled career."

At this time Mr. Ingersoll certainly felt no inclination for political life, and it was not till after he appears to have resolved on withdrawing from the bar, that he yielded to the solicitations of his political friends to enter Congress. The other exceptional case is in reference to a singular event in his life.

"Dec. 5, 1827. — Returning from an arbitration at about half-past ten o'clock, as I entered Willing's alley, I was forcibly assaulted behind by a blow on my head from an unknown person, who immediately escaped. The force of the blow was broken by my hat, which was deeply indented, but my head was unhurt, though I staggered and nearly fell. The escape was providential, either from the attack of an assassin, who meant to wreak his vengeance on me or on another person, or of a robber, who, finding his aim had not been quite true, ran to avoid detection.— *Laus Deo.*"

Besides these professional memoranda, this Diary contains now and then a reference to the death of some member of the bench before whom he had practiced — always with an expression of profound respect and truthful appreciation of his character. I will trespass on the patience of the Society by reproducing a few of them.

"April 30, 1827. — The venerable and excellent Chief Justice Tilghman died last night. He had entered his seventy-first year on the 12th of last August. Few men have gone through a course of judicial labor with more usefulness to the public — nor with greater purity of purpose or integrity of conduct and of heart."

"Nov. 16, 1867. — Judge Duncan, of the Supreme Court, died at Lancaster. An able, acute and learned man. His loss will be severely felt in a community whose judicial appointments are the rewards too often of political subserviency, and when the distribution of them is committed to those who are incapable of appreciating their importance."

There was perhaps no subject upon which Mr. Ingersoll felt more deeply and expressed himself more strongly. It is to be observed that this remark was made when the appointment was by the Governor, and the term during good behaviour. Yet he was not in favor of any change in the system — as he warmly opposed both the alteration in the Constitution by which the tenure was reduced to a term of years, and that subsequent one by which the choice was referred to the people at the polls. Under both systems — under all systems — incompetent men will occasionally receive judicial appointments — but it remains to be seen whether political subserviency will be most successful with a single appointing, or a numerous electing body. The people

at large ought to be deeply impressed with the consideration that the election of a judge rises in importance far above any political office, and to exercise in all cases their own impartial judgments, uninfluenced by mere party considerations.

"Nov. 26, 1829 — The profession and the country have sustained a heavy loss in the death of Judge Washington, who died about two o'clock this afternoon at the Mansion House hotel in this city. He has been for many years an able and upright public functionary. Of late his usefulness has been somewhat diminished by frequent illness, and by his devotion to his wife, whose mind had become somewhat affected, and she had withdrawn from all intercourse with society, and given to and received from her husband mutual and unbounded attention. The keenness of her feelings for his loss permitted her to survive him but eight-and-forty hours; for on Saturday, the 28th inst., having commenced a journey to Mount Vernon, she suddenly died about six miles from town, either actually in the carriage, or before she could be conveyed to a house."

These memoranda were no doubt written without the most remote idea that they would ever meet the public eye. I will add here, as pertinent, the remarks which, many years afterwards (Feb. 12, 1836), he made in the hall of the House of Representatives of the United States, upon a resolution offered by him to have a marble bust of Chief Justice Marshall placed in the room of the Supreme Court at Washington.

"I am not about to pronounce an eulogium on the character of John Marshall. His merits are already recorded in the breasts and judgments of his countrymen. A recollection of them will be cherished as long as a just estimate can be formed of brilliant talents and unspotted integrity, as long as gratitude shall continue to be a virtue. Few men since the formation of the government, have served it so well, and none so faithfully. In the administration of the laws, under a government of laws, he was for nearly five-and-thirty years, supreme in station, in abilities, and in usefulness. It has been the peculiar fortune of this republic, that it has found, on different occasions, when it has called its eminent citizens to posts of public duty, a happy fitness in the individual to his station; a devotion of purpose in the man, and a confidence in his designs on the part of the people: a union and an aptitude from which nothing but lasting benefits can arise.

Many deserving properties were centered in the eminent person, to whom it is the object of this resolution to offer a public tribute of respect and gratitude: properties which justify the feeling universally entertained for him as the pride and boast of his countrymen. When this and much more shall be done by them, the nation and posterity will continue to be immeasurably his debtors. I submit the resolution as a cheerful acknowledgment of the debt we owe, and as the pledge of an effort to repay it in the emulation of his virtues."

It is a very high testimonial to the estimation in which Mr. Ingersoll was held as a lawyer and a man, that so many young men were placed under his direction by their own choice or that of their parents or guardians, to be trained for the bar. I have a list taken from his Diary, commencing in 1826, of forty-five names: some eight or ten preceded that period. His course toward them was marked by great fidelity as well as kindness. He not only prescribed their course of reading, and examined them at short stated intervals as to their progress, and understanding of the subject — but took care by employing them in the preparation of pleadings and other legal papers — in making searches in the offices, and occasionally attending before magistrates and arbitrators, that they should be initiated in the practice of their profession. He was always ready to resolve their doubts, or to explain what they could not understand in the course of their studies. He followed them after their admission to the bar, with advice and encouragement, associating them with him in the trial of causes, and manifesting in every way a deep interest in their success. Many of them have done honor to his instructions by eminence in their profession, and have concurred in cherishing and expressing on all suitable occasions, their confidence, respect, and affection for him. To me it is a source of pride and gratification, that having been one of his students, and honored as I believe with his friendship and regard after leaving his office, I am permitted the privilege, on an occasion like this, to record my sense of the obligation under which he placed me, and to testify my reverence and gratitude. *An quicquam nobis tali sit munere majus?*

Mr. Ingersoll's character at the bar was that of a polished advocate. No man more thoroughly identified himself with the cause of his client, and threw his whole soul into it. Indeed, his

confidence in his clients was perhaps excessive — he did not receive their statements with that distrust, nor make those allowances which ought always to be made for exaggerated partisan accounts. Hence he was often in consequence provoked by the deception practiced upon him. His style of oratory was graceful, earnest, and at times impassioned. He never failed to secure the attention of the jury. To the Court he was equally faithful as to his client. In all the cases he argued, his industry and research enabled him to communicate to the Court all the light on any question to be derived from books. He was eminently courteous in his manner to all engaged with him. Neither witnesses nor opposing counsel could complain. Mr. Ingersoll in effect left the bar in 1841 — or soon after: though he undoubtedly tried and argued several cases of importance after that, and continued much longer to give advice to his former clients in their affairs.

In October, 1832, he was elected a member of the Select Council of the City of Philadelphia, and was immediately chosen the president of that body: which position he continued to hold by annual election until 1835. In 1834 he was elected a member of the 24th Congress — took his seat in December, 1835 — but having served through that Congress, declined a re-election. However, in 1841, he was induced again to enter political life, was elected to, and served successively in the 27th, 28th, and 29th Congresses. He took an active part in the proceedings. He made no speeches for "Buncombe." Some of his efforts, however, were of an elaborate character, and maintained and adorned his reputation as a jurist and a statesman. Among many others which need not be particularized, I may mention his speech delivered December 22, 1835, on the question of referring petitions for the abolition of slavery in the District of Columbia: on May 24, 1836, in favor of the distribution of the surplus money in the Treasury of the United States among the several States, for the purpose of internal improvement and education: on January 13, 1842, on the Treasury Note Bill: on May 12, 1842, on the General Appropriation Bill: on August 1, 1842, on the Reorganization of the Army: on March 31, 1846, on the Subtreasury: on April 14, 1846, on the Oregon Bill: on July 2, 1846, on the Tariff. I cannot forbear transcribing here a short extract from his speech

on the Fortification Bill, as presenting, in very happy language, the most important feature of our Federal system.

"It is the true policy of the Constitution that the National Government should be as seldom as possible seen and felt; that in all external relations it should present the formidable aspect of power, and the means of prosperous and successful intercourse with foreign nations; but that at home even the benefits which it sheds upon its own citizens should be experienced as nature receives and prospers under the influence of her refreshing dews, while the sources from which they flow are imperceptible."

His course throughout was undoubtedly consistent with the political opinions he always maintained and advocated. To enter upon an explanation or illustration is not expected, and would be out of place on this occasion. In the 24th, 28th, and 29th Congresses, he was a member of the Committee of Ways and Means. In the 30th Congress he was Chairman of the Judiciary Committee.

After his retirement from Congress, President Fillmore, with whom he had served in that body, and who knew his abilities, tendered him a seat in his Cabinet as Secretary of the Navy, which, however, he did not accept. In the spring of 1852, he was nominated and confirmed by the Senate as Envoy Extraordinary and Minister Plenipotentiary to the Court of St. James. He arrived in London October 5, 1852, and on the 16th had his audience of reception by the Queen. He remained abroad one year, during which time he negotiated two treaties of considerable importance. By one of them (Feb. 8, 1853), a commission was appointed under which all claims of the citizens or subjects of either country on the other, arising subsequent to the Peace of Ghent, December 24, 1814, were finally adjusted and settled.

It is wonderful that through all this busy professional and political life, Mr. Ingersoll could contribute so much to the cause of polite literature. Very soon after his admission to the bar, he made a worthy youthful attempt to pay in advance that debt which, according to Lord Bacon, every man owes his profession. He translated from the Latin of Roccus, and published with notes, his "Manual of Maritime Law, consisting of a Treatise on Ships and Freight, and a Treatise on Insurance." Chancellor Kent, though he criticises a single passage as omitting two material words, adds: "I mention this without the least intended

disparagement of that very useful translation, the general accuracy of which is undoubted." 3 Kent's Com. 265, n. In another place he admits the justice of the analogy, asserted by Mr. Ingersoll, between the treatises of Roccus and Littleton. 3 Kent's Com. 346.

I cannot pretend to give a full list of all Mr. Ingersoll's efforts, professional and literary, which have been given to the public — much less remark upon their respective characters. Many trials of interest are extant in print, in which he bore part as advocate. An argument made before the General Assembly of New Jersey, on the memorial of the Trenton and New Brunswick Turnpike Company, for the amendment of their charter on February 19, 1834, is a favorable specimen of his power on a question somewhat broader than that usually presented to courts and juries. Of his various discourses, addresses, and orations before different bodies, I can only specify the principal.

Oration before the Washington Benevolent Society, July 5, 1813.

Discourse before the Philomathean Society of the University of Pennsylvania, 1828.

Oration before the American Whig Society of Princeton.

Address before the Phi Beta Kappa Society of Bowdoin College, Maine, September 7, 1837.

Address before the Franklin Institute at the close of their first exhibition of American Manufactures.

Eulogy on General Zachary Taylor, by request of the City Councils, October 2, 1850.

Oration before the Literary Societies of Lafayette College.

Address at the opening of Wills' Hospital, March 3, 1834.

Obituary notice of Henry D. Gilpin, read before this Society.

Memoir of Samuel Breck, delivered before the Historical Society of Pennsylvania, of which he was the President, January 12, 1863.

Address before the National Convention of Young Men's Societies for Moral and Intellectual Improvement, October 29, 1834.

Address at the annual meeting of the Pennsylvania Colonization Society, October 25, 1838.

Of Mr. Ingersoll personally and socially it may be said that he was a gentleman in the truest sense of the word. His manners

were elegant and refined. His conversation easy and interesting. His house was the seat of open and liberal hospitality — his board the constant scene of intellectual enjoyment. He was fond of entertaining strangers. His charity may be termed munificent. He considered it a duty and a privilege to give: it was a pleasure to him, whether in a subscription to some public object, or in strictly private alms — when the left hand knoweth not what the right doeth — he was free — free to a fault. Perhaps it was best to err on the right side.

Unfortunate in the loss of his wife and children, the greater portion of his latter years were passed in childless widowhood. He was not what is called a demonstrative man, but it was in his case as it is in many others, the grief that speaks not outwardly, is that which is felt and dwelt upon most deeply and keenly. He was no doubt sustained amid all his trials by a strong religious faith, for no man had a more unwavering one in the truth and power of Christianity. He was a communicant of the Protestant Episcopal Church, and one of the Wardens of St. Peter's Church in this city, which office he still held when he died.

He was in the eighty-second year of his age when he passed away, February 20, 1868. *Semper honos, nomenque tuum laudesque manebunt.*

Prof. T. C. Porter exhibited nine drawings of figures, rudely but plainly cut by the Aborigines, in the face of the rocks which form the shore and small islands of the Susquehanna River, near the Maryland State Line. The drawings were made by Mr. S. G. Boyd of York, York county, Penna. They are fac similes in size and character, having been obtained by applying the paper sheets to the sculptured surfaces. Some of the figures pass down to or into the water at the ordinary level of the river. Four of the groups bear a remarkable resemblance to the concentric circles with radial grooves figured by Dr. J. Y. Simpson of Edinburg, in his recent work upon the rock sculpture of the Druid *men-hirs* of the British islands. Plate XIII. of this volume is a photolithographic reduction to a scale of about one-eighth of nature, by Osborne's process.

The Society was then adjourned.

TIDAL RAINFALL OF PHILADELPHIA.

Read July 17th and October 2d, 1868.

By Pliny Earle Chase.

I have already given a portion of the evidence which indicates a tendency to increase of rain at quadrature and decrease at syzygy. In order to ascertain how far that evidence may be confirmed or modified by other considerations, it seemed desirable to undertake a more general examination and comparison of observations. The data for such an investigation were derived from the following sources:

1. The meteorological register of the Pennsylvania Hospital at Philadelphia, covering a period of forty-three and a half years, from January 1, 1825 to July 1, 1868. This register was in charge of Newberry Smith from 1825 to 1828, of Franklin Smith from 1828 to 1831, and of Dr. John Conrad from April 1, 1831, to the present time.

2. The published record, in three octavo volumes, of five years' observations at Girard College, Philadelphia, from June 1, 1840, to July 1, 1845.

3. The register of Prof. James A. Kirkpatrick, of the Central High School, Philadelphia, from July 1, 1851, to July 1, 1868.

4. Mr. Glaisher's summary of six years' hourly observations of the rainfall at Greenwich, England, in the Proceedings of the [British] Meteorological Society, Vol. IV. No. 33.

5. Mr. Dines's discussion, in the same Proceedings (Vol. IV. No. 36), of forty years rainfall at Cobham Lodge, Surrey, England.

6. Blodgett's tables of monthly rainfall at thirty-seven stations in Western and Southern Europe, and nineteen stations in Central Europe and Asia.*

7. Loomis's table of monthly rainfall at forty-five North American stations.†

In the preliminary comparison the Hospital observations were arranged in weekly groups for each quadrature and syzygy, and for each apsis, the critical day in each group being the mid day of the seven. They were also arranged according to the moon's latitude and declination. From the results of this comparison, which are given in Tables I—III., as well as from the portions

* Climatology of the United States, pp. 64-5.

† Treatise on Meteorology, pp. 278-9.

TABLE I.

Amount of Rain at Philadelphia, in different portions of the Lunar Month.

YEARS.	Week of New Moon.	Week of First Quarter.	Week of Full Moon.	Week of Last Quarter.	Two Weeks of Syzygy.	Two Weeks of Quadrature.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1825–34	92.47	87.52	88.72	100.57	181.19	188.09
1835–44	93.64	106.83	100.72	113.49	194.36	220.32
1845–54	91.05	94.25	108.00	96.98	199.05	191.23
1855–64	113.45	112.71	86.02	114 24	199.47	226.95
1825–68	436.31	439.86	447.53	460.43	883.84	900.29

TABLE II.

Amount of Rain at Philadelphia, at various Critical Lunar Periods.

YEARS.	Week of Perigee.	Week of Apogee.	North Declination.	South Declination.	North Latitude.	South Latitude.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1825–34	94.20	105.67	180.73	170.52	161.66	202.87
1835–44	90.42	111.98	211.91	206.60	212.06	203.59
1845–54	106.40	106.23	196.20	198.56	188.35	199.15
1855–64	118.31	109.21	202.77	218.73	201.37	220.27
1825–68	459.22	479.73	868.69	893.14	857.61	902.59

TABLE III.

Number of Storms at Philadelphia, at different Lunar Periods.

YEARS.	Week of New Moon.	Week of First Quarter.	Week of Full Moon.	Week of Last Quarter.	Week of Perigee.	Week of Apogee.	North Declination.	South Declination.	North Latitude.	South Latitude.
1825–34	216	196	212	229	238	237	418	411	406	439
1835–44	237	272	256	265	230	272	485	531	525	502
1845–54	294	268	278	276	298	281	543	558	559	552
1855–64	289	311	272	300	310	328	568	610	564	602
1825–68	1141	1152	1131	1168	1206	1239	2216	2348	2280	2298

of the day in which rains were most prevalent (Table IV.), it appeared probable that *an increase of tidal attraction is accompanied by a tendency to fair weather, and a diminution by a tendency to increased rainfall.* The tendencies are, however, so

TABLE IV.

Number of Rains in different Quarters of the Day, at Philadelphia.

YEAR.	RAINS ON SOLAR QUARTER-DAYS.											
	Beginning.				Continuing.				Ending.			
	h. 21 to 3	h. 3 to 9	h. 9 to 15	h. 15 to 21	h. 21 to 3	h. 3 to 9	h. 9 to 15	h. 15 to 21	h. 21 to 3	h. 3 to 9	h. 9 to 15	h. 15 to 21
1851(½y)..	15	32	10	10	26	49	29	23	11	31	16	12
1852.....	38	45	17	21	54	64	34	43	35	35	14	25
1853.....	31	52	23	20	54	76	35	40	33	50	25	19
1854.....	28	42	15	13	67	72	46	46	39	40	11	20
1855.....	34	43	14	29	70	75	54	57	40	37	20	26
1856.....	35	38	6	23	56	68	37	41	30	39	8	14
1857.....	33	48	22	40	64	84	52	68	25	46	24	55
1858.....	39	47	33	35	66	81	60	71	39	46	57	43
1859.....	39	62	37	25	78	103	73	56	44	49	50	19
1860.....	52	75	37	22	79	106	83	51	42	58	56	24
1861.....	39	57	36	34	65	78	72	54	41	46	49	24
1862.....	35	55	34	35	80	89	85	69	51	44	47	21
1863.....	39	51	35	31	82	96	82	62	41	52	47	23
1864.....	38	47	41	35	75	83	70	61	42	49	46	26
1865.....	36	46	34	21	72	86	67	54	34	48	42	20
1866.....	34	49	35	17	65	85	82	48	31	39	48	10
1867.....	44	55	45	37	90	104	90	76	46	59	54	36
1868(¼y)..	19	21	19	13	47	53	53	34	17	21	30	10
17 years...	628	865	493	466	1190	1452	1104	954	641	789	644	427

YEAR.	RAINS ON LUNAR QUARTER-DAYS.											
	Beginning.				Continuing.				Ending.			
	h. 21 to 3	h. 3 to 9	h. 9 to 15	h. 15 to 21	h. 21 to 3	h. 3 to 9	h. 9 to 15	h. 15 to 21	h. 21 to 3	h. 3 to 9	h. 9 to 15	h. 15 to 21
1851(½y)..	8	20	15	17	24	31	30	32	10	18	14	16
1852.....	27	32	34	27	45	50	51	49	25	28	23	30
1853.....	38	28	19	39	60	62	43	64	22	37	18	38
1854.....	26	24	19	34	62	64	49	60	23	36	22	27
1855.....	28	30	34	27	72	65	65	70	30	33	25	25
1856.....	27	29	23	24	56	57	53	53	23	20	19	26
1857.....	39	28	24	30	82	91	73	68	27	33	24	28
1858.....	40	35	22	32	85	82	69	74	42	34	21	23
1859.....	29	49	25	30	79	99	79	76	25	38	26	24
1860.....	37	43	21	38	80	91	65	73	28	41	28	30
1861.....	34	43	23	26	76	93	62	63	20	48	22	28
1862.....	35	29	24	26	85	87	83	74	28	27	26	21
1863.....	22	44	33	30	66	88	84	81	28	30	28	33
1864.....	40	33	25	33	73	80	75	75	34	31	27	37
1865.....	28	36	23	25	67	76	70	77	23	29	20	36
1866.....	34	29	22	25	74	77	62	62	25	35	27	22
1867.....	44	33	31	38	89	85	90	78	37	32	36	38
1868(¼y)..	20	11	18	13	47	46	44	39	14	20	16	11
17 years...	556	576	435	514	1222	1324	1147	1168	462	570	422	493

slight as to be easily overcome, and sometimes for five or more consecutive years, and for periods of ten years or more, this law of precipitation appears to be entirely reversed. Some indications of a probable cause for this vacillation appeared to be furnished by the barometric octantal tides which I had previously pointed out (*ante* IX., 398; Proc. Roy. Soc. June 16, 1864), and these indications were strengthened by Mr. Hennessey's report of the observations at Mussoorie, which showed not only a greater rainfall at each quadrature than at either syzygy, but also a general octantal maximum.

TABLE V.

Philadelphia Rainfall and Barometric Means on different days of the Lunar Month.

Age of Moon.	1825 to 1834.	1835 to 1844.	1845 to 1854.	1855 to 1864.	1825 to 1868.	Barom. Obs'ed. 1840-5.	Barom. Normals 1840-5.
						Inches.	*Inches.*
0	15.68	13.48	12.25	14.76	63.04	+.013	+.006
1	7.34	15.45	14.71	15.39	59.04	+.019	+.008
2	8.99	11.04	14.06	16.16	54.88	—.001	+.006
3	15.74	14.78	11 72	19.53	73.92	+.003	+.000
4	19.02	15.35	17.36	14.49	74.41	+.000	—.010
5	7.94	8.93	14.59	20.89	55.88	—.030	—.021
6	10.87	19.93	9.96	15.37	62.56	—.035	—.027
7	13.89	12.91	13.80	16.49	64.36	—.034	—.029
8	12.55	13.92	15.38	13.76	60.73	—.011	—.029
9	13.49	17.22	9.48	15.55	61.17	—.042	—.028
10	12.39	19.02	14.39	15.98	66.09	—.045	—.018
11	12.55	15.54	11.45	14.55	56.98	+.020	—.002
12	14.02	17.02	12.27	10.08	59.05	+.022	+.012
13	10.67	22.72	18.84	8.88	64.97	+.015	+.018
14	8.59	14.21	11.23	11.19	57.19	+.034	+.020
15	11.22	11.11	14.29	10.53	63.44	+.047	+.019
16	11.31	18.38	15.45	14.23	69.73	—.013	+.012
17	14.94	11.96	20.50	15.17	72.51	+.014	+.004
18	16.59	16 24	21.94	20.62	81.00	—.002	—.004
19	15.11	20.28	15.17	17.96	72.26	—.012	—.013
20	13.97	10.03	17.09	23.82	68.73	—.032	—.018
21	16.30	18.12	12.92	14.60	68.49	—.031	—.013
22	13.68	17.22	9.83	12.65	57.15	+.019	+.002
23	17.95	18.41	15.57	17.01	74.59	+.004	+.018
24	13.04	23.72	14.53	11.30	68.22	+.050	+.028
25	13.89	8.24	9.17	15.32	49.37	+.029	+.028
26	9.94	7.29	15.2[illegible]	23.04	61.92	+.031	+.019
27	18.95	16.39	18.21	17.98	79.11	—.011	+.008
28	13.23	13.78	13.92	15.30	59.67	+.006	+.001
29	6.98	7.11	6.08	3.34	26.09	— 014	+.002

I was therefore led to plot and compare the pluvial and barometric curves, smoothing the irregularities by Airy's method. The normal ordinates (η_i) were each derived from seven successive observations (y) by the formula $\eta_n =$

$$(y_{n-3}+6y_{n-2}+15y_{n-1}+20y_n+15y_{n+1}+6y_{n+2}+y_{n+3})\div 64$$

This formula appeared to give sufficient weight to any possible shifting of lunar influence, by prevailing winds or other occasional disturbances.

For greater symmetry and simplicity the normal lunar month was assumed to consist of thirty days, the 30th day (moon's age 29) being computed by the formula

$$y_{29}=(y_{28}+4y_{28\frac{1}{2}}+y_0)\div 4$$

The solar hourly barometric curve was constructed from the values given in Guyot's tables (Bache); all the others, from the results of original computation.

TABLE VI.

Number and amount of Heavy Rains (1 *inch or more*) *at Philadelphia, on different days of the Lunar Month.*

Age of Moon.	1825–34.	1835–44.	1845–54.	1855–64.	1825 to 1868.			Amounts Exceeding			
								In. 1.5	*In.* 2	*In.* 2.5	*In.* 3
	No.	No.	No.	No.	No.	Amt.					
0	5	2	3	4	17	20	*In.*	14	9	7	7
1	2	3	3	5	14	24	..	14	4	4	4
2	4	1	3	5	14	21	..	6	3	3	0
3	6	6	2	6	24	34	..	17	5	3	0
4	6	5	9	6	29	48	..	31	16	8	3
5	1	2	4	6	15	21	..	15	7	5	0
6	3	6	2	7	19	28	..	17	4	0	0
7	2	6	6	5	21	33	..	17	12	5	0
8	3	5	6	5	21	29	..	21	5	3	0
9	3	3	0	4	12	29	..	18	11	11	11
10	2	3	6	5	17	23	..	12	5	3	3
11	3	5	3	4	16	24	..	13	8	6	3
12	4	5	2	3	14	23	..	13	7	3	0
13	2	8	5	3	20	27	..	11	8	6	0
14	2	4	3	3	17	25	..	11	6	6	3
15	4	3	5	4	19	33	..	21	18	14	11
16	3	3	5	2	18	32	..	17	9	7	7
17	5	5	8	8	29	39	..	23	4	0	0
18	6	7	6	6	26	52	..	37	29	20	7
19	3	7	3	7	21	31	..	15	8	3	3
20	4	2	3	7	18	35	..	21	16	14	12
21	4	7	5	5	24	38	..	24	14	3	3
22	4	6	5	5	21	33	..	22	15	8	8
23	6	3	6	6	24	42	..	19	14	10	10
24	5	7	6	2	22	36	..	18	13	9	6
25	5	1	4	6	16	19	..	9	2	0	0
26	3	2	4	10	20	38	..	25	20	16	13
27	8	5	7	6	29	42	..	24	12	3	3
28	5	5	5	5	21	38	..	23	11	3	0
29	3	3	1	0	7	11	..	6	4	0	0

The data for determining the Philadelphia hourly rains are not so satisfactory as those for the daily rains. A self-registering gauge was kept at Girard College, but the oft-repeated mar-

ginal notes, "gauge out of order," "rain gauge did not register the hourly fall throughout this month," &c., makes it difficult to decide how much weight should be attached to its records. The Hospital register rarely fixes the limits of a storm with sufficient precision. Prof. Kirkpatrick notes the time of beginning and ending during the day hours, and in some cases at night, and he also gives the amount of fall, after April 1, 1854. Whenever I desired to consider that amount in connection with his earlier observations, it was taken from the Hospital register. Where no more definite marking was available the rain of each storm was distributed equally over the hours of its continuance, the night being considered as beginning at 11 *h.* 30 *m.* and ending at 16 *h.* 30 *m.* From the observations thus arranged the deviations from the mean values were calculated, and those deviations were joined to the Hospital means in order to secure uniformity of standard for comparison.

A combination of the monthly values (Table X.) furnishes the following results:

I.	Philada. 43 years.	Amer.	Marit. Europe.	Central Europe and Asia	Average
Mean of March and September (equinoctial)..	149.4	4.72	2.72	2.35	3.27
" one month from equinoctial months.	154.7	4.13	2.83	2.14	3.03
" one month from solstitial months....	157.7	5.05	2.84	2.25	3.38
" June and December (solstitial).....	167.6	5.16	2.77	2.42	3.45
II.					
" December and January (perihelion)..	150.4	4.56	2.99	1.60	3.05
" November and February.....	138.7	4.04	3.00	1.52	2.90
" October and March.....	146.5	4.20	3.08	1.85	3.04
" September and April.....	153.8	4.55	2.70	2.32	3.19
" August and May.....	180.3	5.14	2.57	3.05	3.58
" July and June (aphelion).....	172.3	5.73	2.48	3.22	3.81
" October to March, inc. (perihelion)...	145.2	4.27	3.02	1.66	2.98
" April to September, inc. (aphelion)...	168.7	5.14	2.58	2.87	3.53
" November to Febr'y, inc. (perihelion)	144.5	4.30	3.00	1.56	2.95
" Sept., Oct., March, April (equinoctial)	150.2	4.38	2.89	2.09	3.12
" May to August, inc. (aphelion).....	176.3	5.44	2.52	3.14	3 70
III.					
" March and April (vernal equinox)....	152.4	3.82	2.33	1.68	2.61
" Jan. to June, inc. "	154.3	4.41	2.50	1.96	2.96
" Sept. and Oct. (autumnal equinox).....	147.9	4.93	3.44	2.49	3.62
" July to Dec. inc. "	159.7	5.00	3.10	2.57	3.56
IV.					
" Spring.....	158.8	4.29	2.35	1.98	2.88
" Summer.....	177.9	5.51	2.57	3.32	3.80
" Autumn.....	148.4	4.86	3.48	2.20	3.51
" Winter.....	142.9	4.17	2.81	1.55	2.84
V.					
" April to August (Full Moon dec. S.) ...	172.4	5.08	2.48	2.84	3.47
" Oct. to Feb. (Full Moon dec. N.).....	144.6	4.33	3.16	1.65	3.04
VI.					
" Warm Semester.....	168.8	5.14	2.58	2.87	3.52
" Cool Semester.....	145.2	4.27	3.02	1.66	2.98

TABLE VII.

Lunar hourly Rainfall at Philadelphia.

☽ hour.	1840–5.	1854–8.	1859–63.	1864–8.	19 7–12 years.
	Inches.	*Inches.*	*Inches.*	*Inches.*	
0	9.45	9.90	8.60	8.85	36.80
1	11.74	8.43	8.94	9.82	38.93
2	9.37	7.97	8.90	9.47	35.71
3	9.79	9.79	9.22	10.41	39.21
4	9.54	9.32	10.43	11.15	40.44
5	9.25	8.70	10.66	10.73	39.34
6	8.51	9.08	10.59	10.49	38.67
7	8.88	8.23	11.12	10.15	38.38
8	11.07	6.95	13.05	9.57	40.64
9	8.25	7.37	12.46	9.87	37.95
10	7.83	7.84	11.13	9.28	36.08
11	8.45	8.00	11.30	9.20	36.95
12	8.71	7.44	10.92	10.05	37.12
13	7.93	7.83	10.68	9.45	35.89
14	11.52	7.71	9.66	9.60	38.49
15	12.30	8.20	10.09	10.14	40.73
16	11.89	8.46	9.53	10.31	40.19
17	11.17	8.16	9.44	10.05	38.82
18	11.19	8.66	9.00	9.81	38.66
19	10.23	9.46	9.54	9.33	38.56
20	9.41	9.53	9.80	9.03	37.77
21	11.34	9.52	10.13	9.55	40.54
22	10.75	9.63	8.96	9.70	39.04
23	11.78	10.17	8.59	8.95	39.49

TABLE VIII.

Solar hourly Rainfall at Philadelphia and Greenwich.

☉ hour.	Philada. 1840–5.	Philada. 1851–68.	Philada. 21 1–12 yrs.	Greenwich 6 years.	Philada. Ratios.	Greenwich Ratios.	Mean Ratios.
	Inches.	*Inches.*	*Inches.*	*Inches.*			
0	9.52	29.27	38.79	2.74	91	77	84
1	9.69	30.31	40.00	3.31	94	93	93
2	10.06	27.41	37.47	3.82	88	107	97
3	10.67	29.44	40.11	4.33	94	121	108
4	9.90	35.70	45.60	4.19	107	117	112
5	10.09	37.93	48.02	4.92	112	138	125
6	9.18	40.27	49.45	3.12	116	87	102
7	10.99	38.14	49.13	2.64	115	74	94
8	12.96	34.24	47.20	3.03	110	85	98
9	14.13	35.13	49.26	2.94	115	82	99
10	10.18	32.40	42.58	3.63	100	102	101
11	10.31	31.44	41.75	3.30	98	93	95
12	9.80	33.60	43.40	3.42	102	96	99
13	9.60	36.88	46.48	3.89	109	109	109
14	8.60	37.68	46.28	3.73	108	105	106
15	8.29	39.43	47.72	3.51	117	99	105
16	8.82	36.12	44.94	4.68	105	131	118
17	9.82	31.52	41.34	4.15	97	116	106
18	9.59	28.95	38.54	4.13	90	116	103
19	9.16	28.07	37.23	3.59	87	101	94
20	9.30	24.96	34.26	3.95	80	111	96
21	9.66	27.84	37.50	3.16	88	89	88
22	9.85	29.75	39.60	3.37	93	95	94
23	10.18	28.82	39.00	2.03	91	57	74

TABLE IX.

Solar hourly Barometric means and Amount of heavy Rains (.25 inch or more per hour) at Philadelphia, 1840–5.

⊙ hour.	Barometer.	Amount of Heavy Rain	⊙ hour.	Barometer.	Amount of Heavy Rain	⊙ hour.	Barometer.	Amount of Heavy Rain
	Inches.	*Inches.*		*Inches.*	*Inches.*		*Inches.*	*Inches.*
0	+.004	.40	8	—.005	.78	16	—.001	2.38
1	—.012	1.30	9	+.002	1.18	17	+.002	2.16
2	—.024	.65	10	+.006	2.02	18	+.012	1.11
3	—.031	.30	11	+.011	.78	19	+.022	3.05
4	—.031	1.04	12	+.002	.51	20	+.028	3.84
5	—.029	1.12	13	+.001	.99	21	+.031	7.70
6	—.023	1.05	14	—.001	1.19	22	+.029	2.18
7	—.014	.96	15	—.003	1.95	23	+.021	2.53

TABLE X.

Monthly Rainfalls.

MO.	PHILADELPHIA AGGREGATES.					ANNUAL AVERAGES.			
	1825 to 1834.	1835 to 1844.	1844 to 1864.	1855 to 1864.	1825 to 1864.	America.	Maritime Eu.	C'nt'l Eu. & Asia.	Mean
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*In.*	*In.*	*In.*	*In.*
Jan.	30.92	36.635	28.067	39.366	143.445	4.51	2.98	1.36	2.95
Feb.	26.06	26.644	34.023	25.015	128.074	3.39	2.45	1.43	2.42
Mch.	31.30	34.142	36.514	33.767	148.048	3.99	2.36	1.71	2.69
Aprl	29.87	40.390	33.830	45.076	156.736	3.66	2.31	1.65	2.54
May	30.20	38.738	41.966	44.332	171.446	5.23	2.39	2.59	3.40
June	36 83	44.223	29.946	48.278	178.012	5.70	2.53	3.00	3.74
July	37.75	49·692	38.220	33.028	166.567	5.77	2.43	3.45	3.88
Aug.	37.28	45.690	42.656	41.883	189.186	5.05	2.75	3.51	3.77
Sept	29.08	33.724	32.099	37.564	150.852	5.45	3.09	3.00	3.85
Oct.	42.25	32.086	28. 12	30.443	145.006	4.42	3.80	1.99	3.40
Nov.	33.66	33.506	36.134	37.417	149.377	4.70	3.55	1.62	3.29
Dec.	29.50	36.171	41.063	38.732	157.271	4.62	3.01	1.85	3-16
Tot'l	394.70	448.551	423.230	454.901	1884.020	56.49	33.65	27.16	39.09

The means (*p.* 528) furnish a basis for interesting comparisons with the similarly deduced magnetic and barometric means (*ante p.* 371). Considered in connection with the Tables (I.—XI.) and the normal curves (Figs. 1—6) they appear to justify the following inferences, most of which, though specially deduced, are presumptively general.

1. The tidal rainfall, like the ocean tides, is affected by "establishments," which depend upon ocean currents, mountain ranges, prevailing winds, and other climatic influences.

2. It is also, like the ocean tides, more marked in low, than in high latitudes.

3. There is a general resemblance between the lunar-daily and the solar-hourly barometric changes. There are, however, only two normal barometric maxima and two minima during the solar day, while there are three of each during the lunar month. The resemblance and the difference seem to be both occasioned by the moon's action upon different portions of the daily barometric ellipsoid. When the moon's upper culmination occurs at night she intensifies, for the whole day, the barometric tendency of the corresponding solar hour; when it occurs by day, this intensification is accompanied and controlled by a marked priming and lagging, which introduce an additional inflection into the lunar curve, — the normal barometric tendencies being accelerated before, and retarded after, new moon.

4. There are some evidences of a similar lunar action upon the monthly barometric means, but a further examination is desirable in order to ascertain the extent and importance of that action.

5. There is a tendency to minima in the frequency and amount of rain near the times of new and full moon, with intermediate maxima. So far as such a tendency is dependent upon the direct action of the sun and moon, positions which favor low ocean tides (quadrature, apogee, south latitude or declination, rising and setting, aphelion, solstice, &c.), favor increased precipitation, and *vice versâ*.

6. But the tidal action is subordinate to thermal influences and changes, which increase either the amount of daily evaporation, the nocturnal condensation of vapor in sea-breezes, or the blending of aerial currents. Such influences affect the "establishment," and in many cases produce opposite results, from similar conditions, in maritime and continental climates.

7. The lunar modification of the barometric ellipsoid, also exerts a much more important influence on the rainfall than the direct and simple tidal agency of the moon. The greatest rains therefore have an octantal rather than a quadrature tendency.

8. The lunar-hourly and the lunar-daily rains, both ordinary and extraordinary, like the lunar-monthly barometric fluctuations, have three maxima and three minima, nearly correspondent in period and opposed in direction to those of the barometer, and attributable to the same lunar priming, lagging and intensification.

9. The solar-hourly ordinary and heavy rains have also an inclination to maxima and minima, which appear to be mainly dependent upon the thermal currents.

10. The principal anomalies in the lunar-daily rainfall at Philadelphia occur near the quadratures, and are attributable to occasional heavy storms. For instance, the abnormal flexures in the curve for 1825–44 (fig. 2), were produced by ten storms, of more than 2.5 inches each, on the 9th–14th and 17th–20th days of the lunar month. It is well to notice that these flexures are added to the curve, without obliterating the traces of barometric mediation.

11. The middle day of the most rainy week in each of the ten years' groupings at Philadelphia occurred after full moon, or during that portion of the lunar month when the moon's action is intensified by a falling barometer and increasing condensation of atmospheric vapor. Schiaparelli likewise found a rainy maximum in Northern Italy, about the time of the last lunar quarter, and Mr. Dines observed that the rain which fell on the 22nd day of the moon's age, in Surrey, "is in all cases above the average, when a period of five years is taken," but I am not aware that any one has hitherto attempted to show the dependence of such a maximum upon any obvious law.

12. A careful examination of the local aerial currents resulting from the moon's barometric and tidal actions, may perhaps help

TABLE XI.—

Age of Moon	0	1	2	3	4	5	6	7	8	9	10	11
Surrey, 1825–64	100	98	97	100	102	102	100	101	105	107	104	101
Philadelphia, 1825–64	93	93	96	100	101	99	97	97	97	98	98	97
" 1825–44	93	88	89	95	96	94	93	96	99	103	105	106
" 1845–64	93	97	102	105	107	105	101	97	95	93	92	88
" 1825–68	93	94	97	102	103	100	97	96	96	96	95	94
" 1 inch or more	78	76	87	101	106	100	94	94	93	87	81	78
" 1.5 inch or more	80	71	76	95	109	108	101	99	99	92	81	72
" 2 inches or more	73	57	56	72	86	85	78	78	79	77	74	72
" 2.5 inch or more	69	68	65	70	77	70	61	65	84	97	92	81
" > .25 inch per hour.	82	61	49	44	44	50	56	58	59	60	62	69
" 2 inches or less	96	100	105	108	105	102	101	100	100	100	99	98
" No. > .25 inch	96	99	104	105	103	102	101	102	100	100	100	99
" Average fall	93	95	97	101	102	99	97	97	97	97	96	97
" ☽ hourly	99	98	98	99	101	102	102	102	101	102	101	100
" ☉ hourly	91	91	92	94	99	105	110	111	114	113	112	109
Greenwich, ☉ hourly	81	90	100	109	115	118	113	104	94	86	84	87
Mean ☉ hourly	86	90	96	101	107	111	112	108	104	100	98	98
Hours of the day	0	.8	1.6	2.4	3.2	4	4.8	5.6	6.4	7.2	8	8.8

to reconcile the discrepant results obtained by different observers of the lunar-daily variations in temperature.

13. These considerations, with the supplementary aid of sufficient local observations to adjust the hourly, daily and monthly "establishments," may furnish data for valuable predictions of normal meteorological conditions.

14. After the direction, magnitude and frequency of the normal changes in the atmospheric pressure and currents have been satisfactorily determined, it seems reasonable to hope that an improved system of "forecasts" may be established which will be very advantageous to agriculture and commerce.

15. The principal terms for meteorological predictions may be thus arranged, in the order of their apparent relative importance at Philadelphia:

Daily range of temperature and consequent aerial currents;
Lunar disturbance of daily barometric pressure;
Distance of the sun;
Solar declination;
Lunar disturbance of monthly barometric pressure;
Lunar hour angle and daily tide;
Lunar declination;
Phase of the moon;
Moon's distance;
Solar tide;
Moon's latitude.

Normal Ratios of Rainfall.

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
98	97	98	98	97	96	97	99	103	104	101	98	99	101	100	99	100	101
95	92	89	91	99	109	116	117	112	107	105	105	102	98	106	103	100	95
105	101	94	91	95	102	108	109	108	110	115	116	108	96	91	95	100	98
85	84	85	91	103	116	124	123	115	103	95	93	95	101	108	109	101	94
94	94	96	100	106	113	115	113	108	104	102	102	99	96	98	101	99	95
78	82	86	99	111	124	128	122	116	115	116	114	107	103	108	114	107	91
69	70	79	94	113	131	136	129	121	119	116	106	96	97	110	119	112	96
73	81	95	107	113	128	145	149	144	142	139	128	113	110	120	122	110	92
78	94	120	133	130	136	153	158	143	127	126	126	120	116	113	93	68	64
72	68	64	54	59	72	89	106	116	118	128	153	192	239	251	225	177	124
98	97	96	99	105	110	109	106	101	96	95	97	96	93	94	97	97	95
98	97	97	100	106	110	110	106	101	97	96	98	96	93	94	97	97	95
98	100	101	102	103	106	107	105	103	103	103	103	99	98	101	105	102	97
97	96	96	96	96	98	101	103	103	102	101	100	100	101	102	102	101	100
106	103	102	103	106	108	109	108	104	99	94	90	86	85	86	89	91	91
91	94	97	100	102	105	108	112	115	116	114	111	107	102	96	89	83	79
98	99	99	101	104	107	109	110	109	108	104	100	96	93	91	89	87	85
9.6	10.4	11.2	12	12.8	13.6	14.4	15.2	16	16.8	17.6	18.4	19.2	20	20.8	21.6	22.4	23.2

EXPLANATION OF FIGURES.

The notched horizontal line, in each figure, represents the mean daily or hourly value; each vertical space represents a deviation of .03 of the mean value, in the rain curves, or of .003 of an inch in the barometric curves; each horizontal space represents a day in the abscissas of the monthly curves, or forty-eight minutes in the abscissas of the daily curves.

Fig. 1. Total lunar-daily rainfall.

Philadelphia, 1825–44; _____ continuous line.
Surrey, 1825–44; ..... dotted line.

Fig. 2. Total lunar-daily rainfall at Philadelphia.

1825–44; ..... dotted line.
1845—64; - - - - - - broken line.
1825–68; _____ continuous line.

Fig. 3. Lunar-daily rains at Philadelphia.

No. of storms exceeding .25 in.; ..... dotted line.
Average fall; - - - - - - - - - - - - broken line.
Amount of rain in moderate storms; _____ continuous line.

Fig. 4. Total hourly rainfall.

Greenwich, solar hourly; ..... dotted line.
Philadelphia; " " _____ continuous line.
" lunar hourly; - - - - - - broken line.

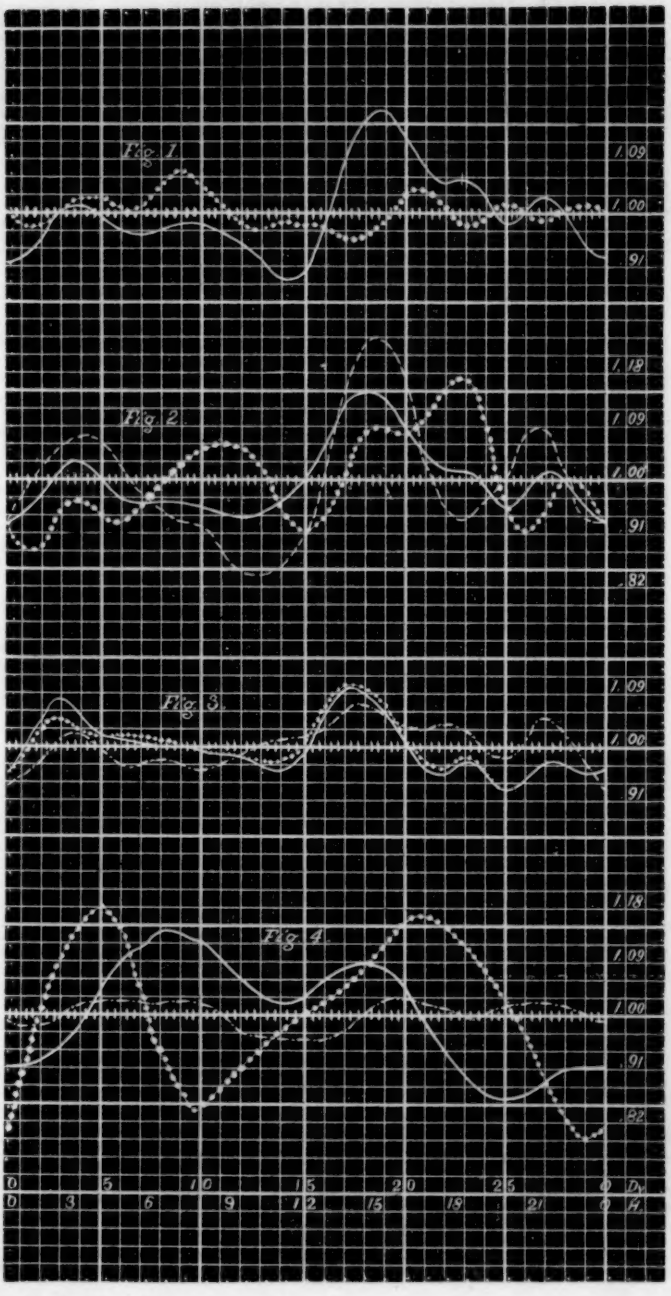
Fig. 5. Barometric fluctuations at Philadelphia.

Solar-hourly; _____ continuous line.
Lunar-daily; - - - - - - - - broken line.

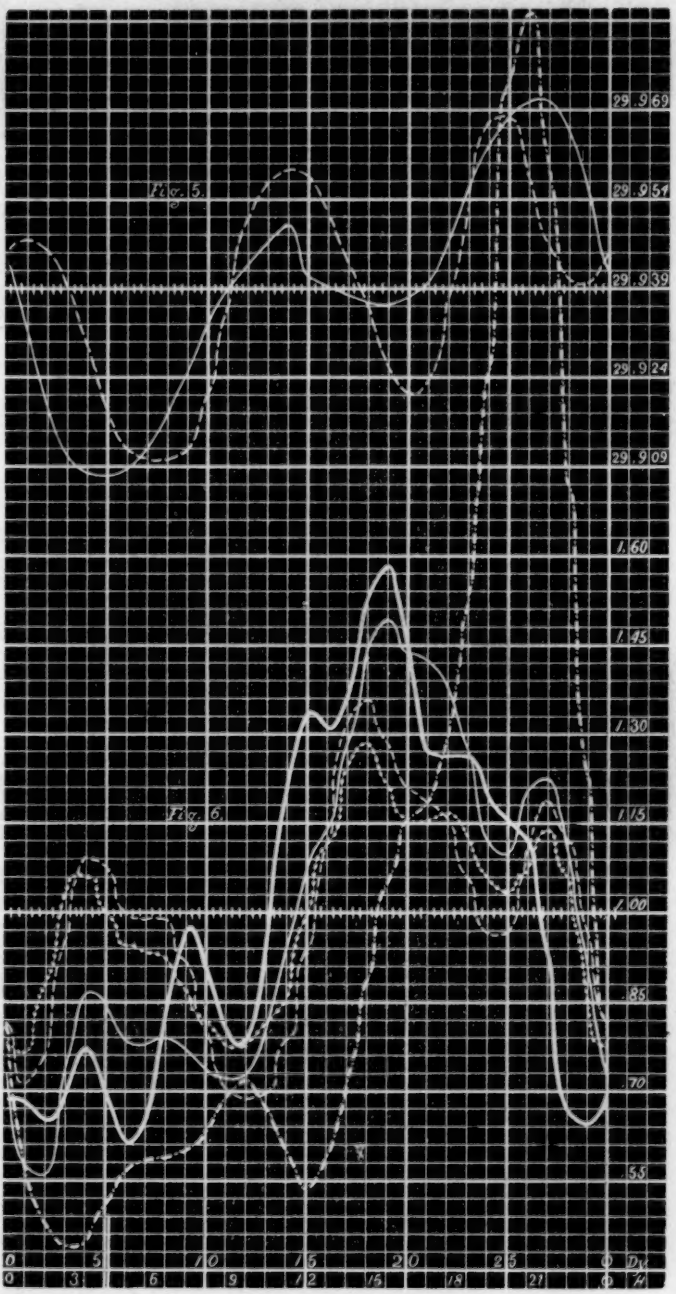
Fig. 6. Heavy rains at Philadelphia.

Lunar-daily amounts, in storms of 1 inch or more; dotted line.
Do. do. do. 1.5 in. or more; broken line.
Do. do. do. 2 in. or more; light line.
Do. do. do. 2.5 in. or more; heavy line.
Solar-hourly, exceeding .25 in. per hour; dotted broken line.

CURVES OF RAINFALL.



CURVES OF PRESSURE, AND OF HEAVY RAINS.



OBSERVATIONS ON THE METEORS OF THE MORNING OF NOVEMBER 14.

By Pliny E. Chase.

Read before the American Philosophical Society, Nov. 20, 1868.

Between 1 h. and 2 h.	155
" 2 h. and 3 h.	163
" 3 h. and 4 h.	206
" 4 h. and 5 h.	221
" 5 h. and 5 h. 28 m.	105
Total, ...	850

The first 100 fell in 35 minutes.
" second 100 fell in 37 minutes.
" third 100 fell in 32 minutes.
" fourth 100 fell in 22 minutes.
" fifth 100 fell in 39 minutes.
" sixth 100 fell in 27 minutes.
" seventh 100 fell in 25 minutes.
" eighth 100 fell in 26 minutes.
" last 50 fell in 15 minutes.

The maximum was about 3 h. Between 3 h. and 3 h. 15 m. 80 were seen. A second maximum, of longer duration, occurred after the fifth hundred, between 3 h. 55 m. and 5 h. There were 51 of remarkable brilliancy, 39 of which fell between 3 h. and 4 h. 22 m. The flashes from 24, in other quarters of the heavens, were so brilliant as to illuminate the neighboring houses. As many as 10 or 12 per minute were frequently seen, and in but few cases was the interval between two successive meteors greater than a minute. Fourteen couples and two triplets were noted. Nearly all the paths radiated from Leo, only 25, or about 3 per cent., being non-conformable. The observations were made from an attic window, looking south and south-east.

Stated Meeting, December 18, 1868.

Present, sixteen members.

Prof. JOHN C. CRESSON, Vice-President, in the Chair.

A letter accepting membership was received from Mr. O. C. Marsh, dated Yale College, New Haven, December 10, 1868.

Letters of acknowledgment were received from the Royal Society Upsal, Linnean Society London, Historical Society Philadelphia, and Boston Public Library.

Donations for the Library were received from the Societies at Moscow, Riga, Upsal, Freiburg i B. and Leeds, the Museums of Natural History at Paris and Buenos Ayres, the R. I. G. B., Royal Geopraphical, Chemical, Linnean and Zoological Societies in London, the Historical Society of Lancashire, Boston Natural History Society and Public Library, United States Mint, Department of Education at Washington, State Geologists of Iowa, and catalogues from foreign booksellers.

A donation for the Cabinet, was received through Dr. Hayden, from Mr. Blackmore: 32 Russian medals electrotyped and distributed by the British Museum.

The Librarian, for Mr. William Clark of Philadelphia, laid before the members a lead pencilled copy of the so called human writing on the roof of a coal mine at Hammondville, on the Ohio river, which had given origin to so many absurd newspaper articles in all parts of the United States.

This quasi inscription consists of a single row of twelve leaf scars of a species of Sigillaria, out of which the imagination finds no difficulty in manufacturing repetitions of the letters B. D. C. O. and the figure 8.

The Secretary read the following extract from a letter signed Jas. F. Latham, M. D., dated Leechville, Beaufort Co.,

N. C., Dec. 7, 1868; as all evidences of the general movement of the Atlantic seaboard are valuable:

In the bottom of all our fresh water rivers and creeks there are large tracts of the bottom covered with cypress stumps and knees precisely as they grew and undecayed, precisely as they are now above the tide in our swamps. These stumps and knees are now from 6 to 8 feet below the tide level; the land must have sunk since they grew. Again, all along the waters of Pamlico sound, where the farms, even in the memory of middle-aged men, were extremely rich, the tide has submerged them, and they will not now produce in some instances even grass, and the people say the tides rule higher than in old times. Again, the shores are washing away everywhere, and making nowhere. So that at least on the shore line of Pamlico sound, there are at least 500 or 1000 acres taken possession of by the sound every year. Again, in cutting a canal to drain Mallamusket lake into Alligator river, a powerful dredge was used, and some three feet below the tide level, they took up a layer of pine stumps, and immediately below these another layer was taken up, and below these still another layer, showing conclusively to my mind that the land for many ages has been, as now, about level with the tide; and the accumulation of vegetable matter compensates for the sinking. Pine will never rot if always under fresh water. We have here also 8 lakes, some 20 miles long, and from that down to 3 or 4, the lands around which for miles are a dead level, and none of them with a regular natural outlet.

On the Shower of November, Meteors as observed at Bloomington, Indiana, November 13–14, 1868.

By Daniel Kirkwood, L.L. D.

The Shower of November Meteors has been this year unexpectedly brilliant. Unfortunately, I was unable to watch the display; but during three hours on the morning of the 13th, Prof. T. A. Wylie, D. D., observed 165. A considerable proportion of these were unconformable. The number, however, radi-

ating from Leo, was sufficient to indicate the commencement of the shower. Remembering that Humboldt, in 1799, had seen a nnmber of meteors after sunrise, I took a position at 8 o'clock, A. M., on the west side of a building (in the shade), and watched the vicinity of the radiant, in the hope of observing some of the largest meteors. Glimpses of 5 or 6 were, as I thought, actually obtained, when, in order to guard against optical deception, I called Mr. Allison Maxwell, a tutor in the State University, who watched about 15 minutes. This gentleman reported that he saw *one* beyond doubt, and three others less certainly. I mention the case as being the first since the commencement of the present century, in which meteors of the November stream have been (probably) seen in the daytime.

On the night of the 13th, a committee of the senior class in the university kept watch from eleven o'clock, P. M., till 4 h. 15 m., A. M., when, having counted 2500, they adjourned. The maximum was about 3 h. 30 m.: 900 meteors having been counted during the 45 minutes immediately preceding. Many of the meteors were very brilliant, leaving long trains, some of which continued visible several minutes. Three or four were observed to explode, or separate into several fragments. No sound, however, was in any case perceived.

At 4 h. 55 m. (40 minutes after the committee at the university adjourned), Prof. Wylie commenced observing at his residence, and continued his watch until 6 h. 11 m., counting 780 in 1 h. 16 m. The whole number therefore actually counted in 6 h. 31 m. was 3280. A portion of the heavens was at times overcast with clouds; especially was this the case shortly after 4 o'clock, when the committee of students adjourned.

At frequent intervals throughout the night a lull occurred in the display; while at other times for a few seconds the meteors were so numerous that they could scarcely be counted.

A remarkable feature in the shower of the present year is its duration. As seen in Europe in 1866, and in this country in 1867, the display was limited to 3 or 4 hours. On the present occasion, however, it commenced on the night of the 12th, and had not ceased at daylight on the morning of the 14th. This would indicate considerable irregularity in the thickness of the stream.

NOTES ON SOME OF THE HISTORICAL AND MYTHOLOGICAL FEATURES OF THE D'ORBINEY PAPYRUS.

By J. P. Lesley.

Read before the American Philosophical Society Nov. 20th, 1868.

This curious relic of the literature of the reign of Ramses II. was purchased by Mrs. D'Orbiney in Italy and submitted to the Vicompte De Rougé in Paris for inspection, who at once recognized its romantic character, and published an abstract of its contents in the *Revue Archæologique*. This gave it a high money value, and placed it beyond the convenience of the Museum of the Louvre to secure it. It was bought by the direction of the British Museum, and published in fac simile by that institution. Parts of it only were translated into English; but many passages were found too obscure for satisfactory translation at that time. Dr. Brugsch essayed a complete translation of it into German in 1864, and published it in his charming little sketch of travels on the Nile, entitled "*Aus dem Orient*," but without making known his opinion of its value as bearing upon the complicated mythological systems of Egypt, and also necessarily without noticing the relation of its principal character to one of the royal cartouches on the second tablet of Abydos, still more recently discovered by M. Dümichen, after the corridors of the palace of Seti I. were exposed to view by the excavations of Mariette Bey.

Before undertaking to show the connection which this papyrus seems to establish between an apparently historical king of the IId dynasty and the hero of a romance of the XIXth (an interval of two or three thousand years), I will give an English version of Dr. Brugsch's German translation, condensing somewhat its more pleonastic passages, but preserving its genuine Egyptian features.

The language and style of all the literature of the XVIIIth and XIXth dynasties, thus far discovered, is known to be simple and artless, like that of the early Hebrew Scriptures; even more childlike and primitive than that of the Homeric poems, which they antedate by six or seven centuries. The story before us is as full of feeling as it is fanciful, or, to speak more after occidental notions, fantastic. It may be called with almost equal propriety a fairy tale or a nursery tale. Its resemblance to

some of the Mosaic narratives will strike every mind. The same directness of action is seen in both; the same tendency to set phrases opening the successive scenes of the drama; the same monotone of narration, like recitative in music; and the same sudden and unexpected flashing out of some more important interest after a wearisome length of childish commonplace. These are, in fact, characteristic qualities common to all vigorous but undisciplined and uncultivated imaginations when charged with the fire of genius, inspired by great events, and unbridled by those rules of taste which successive ages of rising civilization have established for modern writers.

Indeed, it would be surprising if no such striking resemblance appeared; for the papyrus purports to be written by a scribe, named *Annana*, for the amusement or instruction of the young prince Seti Menephta, during the reign of his father, the Greek Sesostris, Ramses II. surnamed Meiamun, third king of the XIXth dynasty, 1450 B. C., more or less. And Egyptologists, who, like Dr. Brugsch, are orthodox believers in the historical value of the Mosaic record, agree in calling this Menephta the Pharaoh of the Exodus, although the monuments record his temporary exile in Ethiopia (of which every heir apparent to the Egyptian empire seems to have been prince by right of birth—a sort of Dauphin)—and his subsequent restoration to the throne,—but not his death in the Red Sea.

To students of the Pentateuch, it will not be needful to point out coincidents between some of the details of this story, and of that of the Hebrew Joseph; they speak for themselves.

"There were once two brothers of one mother and one father, the elder Anepu, the younger Batau. And Anepu had a house and wife; and his younger brother was like his son, and made him clothes, and followed his herds, and helped till the fields after ploughing was done, and was a good worker; there was not his equal in all Egypt.

After many days, the younger was, as usual, with the cattle, driving them home each evening, laden with fodder from the fields, to give them food. The elder sat with his wife, eating and drinking, while the younger was in the stable with his cows.

And when the earth shone with a new day, and the lamp [no longer burnt] he rose before his elder brother was awake, and

drove the cattle afield, and carried their meals to the field hands, and then followed his herd, who told him where the good grass grew, he listening to their words and driving them accordingly; so that they grew large and increased in numbers greatly.

In ploughing time his elder brother said to him: Let us take teams and plough, for the soil shows [above the inundation] and it is a good time to plough; bring seed to the field, and we will plough . . . . . And his younger brother did as he was told.

And on the morrow they went and had their full of field work, and enjoyed it.

And after many days they were in the field, and [wanted seed], and he sent his younger brother, saying: Haste, bring seed out from town. And he found his elder brother's wife sitting, braiding her hair, and said to her: Arise, and give me seed, for I must hasten to the fields; my brother ordered me not to dally here. She said to him: Go, open the seed chamber, and take what thy soul wishest, for my hair might come untwisted if I went. So the young man went to his stall and got a large basket, for he wished to take much seed, and filled it with wheat and barley, and bore it thence. She asked: How much? He replied: Three measures of barley and two of wheat, in all five, are in my hands. Thou art very strong, said she, as I have often noticed. And her heart recognized him . . . . and she . . . . . burnt towards him and said: Come, let us have a good quiet hour. Dress up! I will give you fine clothes. Then was the young man as mad as a panther at this wicked speech of hers: and then she grew very much alarmed. For he said to her: Woman, thou art in the place of a mother, and thy husband of a father to me; for he is enough older than I am to be my father. What a great sin hast thou said to me! but if thou dost not repeat it, neither will I let a word of it escape my mouth to any one. And taking up his burden, he went out to the fields, and joined his elder brother, and they were busy and finished their work.

When the day was at an end and the evening had arrived, then turned the elder brother to go home, but the younger followed his cattle, loaded himself with all kinds of green produce, and drove them to the stable, to the stall, in town. And lo! the elder brother's wife, alarmed at the words that she had uttered, had wounded herself, and represented herself as having been overpowered by some wicked person, intending to tell her husband:

Thy younger brother hath overpowered me. So when her husband returned, as usual, in the evening, and entered his house, and found his wife lying there, as if some scoundrel had mis-handled her, and did not give him water for his hands as usual, nor lit the lamp before him, so that his house was in darkness, but lay there pale and faint, her husband said: Who has been talking to thee? Stand up. She said to him: No one has spoken to me except thy younger brother. When he came in to get seed corn, and found me sitting alone, he said to me: Come, let us have a good quiet hour; put on thy handsome clothes. That was what he said to me. But I did not listen to him. See, said I, am I not thy mother, and thy brother, is he not a father to thee? That was what I said to him. And then he became alarmed, and did violence to me, so that I should not inform against him. If, then, you let him live, I shall die. See! he came to . . . . if I bear this wicked language, he will certainly do it.(?) At this the elder brother was as mad as a panther, and sharpened his axe and took it in his hand, and placed himself behind the stall door, to kill his younger brother on his return in the evening, driving his cattle home to the stall. And when the sun had set, and he had loaded himself with all kinds of fodder, as was his wont, he approached, and his first cow entered the stall, and said to her driver: Beware of thine elder brother, he stands before thee with an axe to kill thee; keep away from him; and he heard what the first cow said. Then went a second in and spake in like manner; and he looked beneath the door of the stall, and saw his brother's feet, behind the door, with an axe in his hand. So he laid his burden on the ground, and fled sadly thence; and his elder brother followed with the axe. And his younger brother complained to the Sun God, Harmachis, saying: Good my Lord, thou art the one to distinguish falsehood from truth. And it pleased the Sun God to hear his cry, and to raise a flood between him and his elder brother, and it was full of crocodiles. And one was on one bank, and the other on the other. And the elder brother made two strokes with his hand, but succeeded not in killing him. That he did. And the younger brother cried from the other bank, saying: Stay and wait till it be daylight on the earth, and when the Sun God rises, I will explain myself to thee, to cause thee to know the truth, for never have I done thee wrong. But where thou art I will not stay, but I will go to the Cedar Mountain.

When the earth had grown bright with a new day, the Sun God rose, and they saw each other; and the younger said to the elder brother: Why pursuest thou, to kill me, unrighteously? Hearest thou not my mouth say: I am truly thy younger brother, and thou wast as a father to me, and thy wife as a mother. Lo, did it not happen, that when thou sentest me to bring seed corn, thy wife said to me: Come, let us celebrate a quiet hour? Now see, she has reversed it all. And he caused him to know what had occurred between him and his wife. And he swore by the Sun God, saying: If it be thy intention to kill me, then stick thine axe in the hole of thy girdle(?) And he drew forth a sharp knife and cut off a member of his body and threw it into the water, and the fishes ate it.

Then sank he swooning and lifeless: but the soul of his elder brother was sorely troubled. And there he stood and wept and mourned, and could not cross over to his younger brother for the crocodiles. And his younger brother called to him, saying: Lo, thou thoughtest evil, and hadst not good in mind therefor; Yet will I inform thee of one thing that thou must do. Go home and tend thy kine, for I will not abide where thou abidest, but will go to the Cedar Mountain. This must thou do when thou comest to look about thee for me. Know that my soul and I must part; I shall lay it in the topmost cedar flower; and when the cedar shall be felled, it shall fall to the earth. If thou comest to seek it, tarry seven years seeking it, and if thy soul can endure so long then thou shalt find it. Then lay it in a vessel with cold water; so will I live again, and will answer all questions, to make thee know what further shall befall me. Let there be in thy hand also a flask of barley water, and pitch it with pitch, and delay not about it, that thou mayst have it by thee.

And so he went to the Cedar Mountain, and his elder brother gat him home, laying his hand upon his head, and scattering dust thereon. And when he entered his house, he slew his wife, and cast her to the dogs, and sat himself down to mourn for his younger brother.

Many days afterwards his younger brother found himself upon the Cedar Mountain, and no man was with him, and he spent the day in hunting the beasts of the earth; and evening came, and he stretched himself beneath the cedar tree in the flowertop of which his soul lay.

Many days afterwards he built himself a hut on the Cedar Mountain, with his own hands, and filled it with all good things, such as he would have in his house. And when he went out, he met the Nine Gods, who were abroad, caring for the whole land. And the company of gods spake together and to him, saying: Batau, thou bull of the Gods, why art thou here alone? Why hast thou left thy land on account of the wife of Anepu, thy elder brother? Lo, his wife is slain. Turn back to him; he will answer all thy questions. And their hearts pitied him greatly.

Then spake the Sun God Harmachis to the god Chnoum: Make now a wife for Batau, that he sit not alone. And Chnoum made him a wife; and as she sat there, she was more beautiful of form than all the women of the land; all godhead was in her. And the Seven Hathors came to look at her; and they said with one mouth: She will die a violent death. And he loved her dearly; and she ate in his house, while he spent the day chasing the beast of the land, to lay the prey at her feet. And he said to her: go not out, lest thou shouldst meet the sea, lest he entice thee away; for I should not be able to save thee from him, because I am womanish like thee, because my soul lies in the topmost Cedar Flower. If another find thee, then must I give him battle. And he opened his heart to her its whole width.

Many days after this Batau was gone forth a hunting as was his daily wont; and his young wife had wandered out to walk beneath the Cedars, which stood behind the house; when lo! the sea saw her and rose behind her; but she saved herself by a hasty flight from him and entered into the house. But the Sea called to the Cedar and said: oh how I love her! and the Cedar gave him a lock of her hair. And the Sea carried it to Egypt, and laid it down on the place where the washermen of the house of Pharaoh were; and the perfume of the lock of hair communicated itself to the Pharaoh's clothes; and there arose a strife among the washermen of Pharaoh; who said: a smell of ointment is in Pharaoh's clothes! and a contest arose thereon daily; and they knew not what they did. But the head washerman of Pharaoh went to the Sea; and his soul was troubled much on account of the daily strife; and he stood and placed himself on the shore, over against the lock of hair, which lay in the Sea; and there was an exceedingly sweet smell therein; and he brought it to Pharaoh.

Then were brought the wise Scribes of Pharaoh; and they said to Pharaoh: that is the lock of hair of a daughter of the Sun God; and all godhead is in her: the whole land worships her; send now messengers throughout all lands to seek for her; but let the messenger who shall go to the Cedar Mountain be accompanied by much people, to bring her hither. See now, said the King, it is very good what ye have said; and they were sent.

Many days afterward came back the people who had been sent to other lands to tell the King their news, but those came not who had gone to the Cedar Mountain; for Batau had slain them, and had left but one of them to tell the King the news. And the King sent people out, many warriors on foot and on horseback, again to bring her; and there was also a woman among them; to whom they gave all kinds of noble woman's trinckets in her hand. Then came the wife back with her into Egypt, and there was great joy on account of her throughout all the land; and the King loved her dearly and exalted her to great beauty. And they spake with her, that she should reveal the story of her husband. Then said she to the King: let the Cedar tree be felled, that he may perish! Then sent they armed men, bearing axes, to fell the Cedar tree; and they came to the Cedar and cut the flower away in the midst of which was Batau's soul, and it fell, and so he died in a short time.

When the earth grew light again and a new day arose, there was the Cedar Tree cut down. Then went Anepu, the elder brother of Batau, into his house to wash his hands; and he took a jug of barley water which he sealed up with pitch, and another jug of wine which he stopped with clay; and he took his staff and his shoes, and his raiment, and provision for his journey, and betook himself upon the way to the Cedar Mountain. And he came to the hut of his younger brother; and he found his younger brother stretched out upon his mat; and he was dead; and he began to weep, when he beheld his younger brother lie stretched out in the condition of the dead. Then went he forth to seek his younger brother's soul under the Cedar Tree, under which his younger brother laid himself at eventide. And he sought for it three days, without finding it; and when the fourth day was past, his soul longed to return to Egypt.

After the earth had become light and a new day had arisen, then he arose and went under the Cedar Tree, and he busied him-

self all day searching for the soul; and as he returned at evening and looked about him yet once more, he found a fruit, and when he had brought it home, lo! it was the soul of his younger brother. Then took he a vase of cold water, laid it therein, and set it down, as was his daily wont.

Now when the night had come, the soul sucked in the water, and Batau lifted himself on all his limbs, and looked upon his elder brother; but his heart was motionless. And Anepu, his elder brother, took the vase with the cold water, wherein the soul of his younger brother was, and drank it out, and lo! the soul found itself in its old place. Then was he as he had been in old times. They embraced each other, and talked together. And Batau said to his elder brother: Look, I will transform myself into a sacred bull with all the sacred marks; they will not know its secret, and thou shalt set thyself upon his back; and when the sun is risen, we will be in the place where my wife is. Answer me, if thou wilt lead me thither? for they will show thee all the favor that is due. They will load thee with silver and gold, if thou wilt lead me to Pharaoh; for I will be a great good fortune; and they will celebrate me in all the land. And thou wilt go to thine own town.

Now when the earth was light and a new day came, Batau had taken on the form which he had described to his elder brother. And Anepu, his elder brother, seated himself upon his back at break of day; and he approached the place, and let the king know; and he looked upon him and was greatly rejoiced, and appointed for him a feast, too great to describe, for it was a great good fortune; and there was a jubilee on his account in all the land. And they brought silver and gold for his elder brother, who remained in his town; and they gave the bull many servants and many things; and Pharaoh loved him very much, more than any man in all the land.

After many days went the bull into the sanctuary, and stood in the same place where the beauty was. Then spake he to her, saying: Look here, indeed I love thee still! Then said she: who art thou then? And he said to her: I am Batau, whom, when thou didst cause the Cedar Tree to be cut down, thou didst teach Pharaoh to know where I was, that I might no longer live. Look upon me; I live yet in very deed; I am now in the form of a bull. Then feared the beauty exceedingly at this saying of

her husband. And when he had gone forth from the sanctuary, and the king sat beside her to make good day for himself, and she found herself in favor with the king, and he showed her grace above all measure, then spake she to the king: Swear unto me by God to fulfill all I shall say to thee! Then he fulfilled all that she said. And she said: Let me eat of the liver of this bull, for thou hast no need of him. Thus she said; but he was very sad at what she had spoken, and Pharaoh's soul was troubled beyond measure.

When the earth had become light, and another day was come, then they prepared a great festival, in order to sacrifice unto the bull; but there went forth one of the chief servants of the king to slay the bull. And it came to pass as they were about to slay him, there stood people by his side. And as he gave him a blow upon the neck, two drops of blood sprang forth upon the place where the two door posts of the king are, the one on one side of Pharaoh's door, and the other on the other. But they grew upwards into two great Persea trees; and each of them stood alone. Then they went to the king to tell him so: Two great Persea trees have grown up in the night to the great good fortune of the king, on the spot where the great king's gate is to be found, and there is therefor joy in all the land.

And after many days, the king was dressed in the collar of lapis-lazuli, and fair chaplets of flowers were upon his neck. He was in a golden car; and when he issued from the royal palace, he saw the Persea trees. And the beautiful wife went forth in another carriage behind the Pharaoh. And the king seated himself beneath one Persea tree. But it said to his wife: Ha, false one, I am Batau; I live still, I have transformed myself. Thou didst teach the Pharaoh my residence in order to slay me; I was the bull and thou didst cause my death.

After many days stood the beauty in the favor of the king, and he showed her grace. Then said she to the king; Swear now to me by God, to do all that I shall say. And he fulfilled her whole speech, and she said: Cause the two Persea trees to be sawn down, and fair planks to be made from them. And they fulfilled her words.

After many days the king sent for cunning craftsmen to cut down Pharaoh's Persea trees, and the beautiful queen stood near and looked thereon; and there flew a splinter of wood into the

mouth of the beautiful woman, and she perceived that she was with child . . . . and they did all that her soul desired.

And it happened after many days that she brought forth a boy; and they went to tell the king: A boy is born to thee. And he was fetched, and they gave him a nurse and waiting women; and joy was in all the land. They sat down to celebrate a festival; they gave him his name, and the king loved him dearly from that hour on; and he called him Prince of Ethiopia.

Now many days after this the king made him governor of all the land.

Now many days after this, when he had fulfilled many years as governor, then died the king; the Pharaoh flew to heaven. And the other said: Bring me now here the great and mighty of the royal court, and I will give them to know the whole history of what has happened in respect of me and of the queen. And his wife was brought to him, and he revealed himself to her before them, and they said their say. And his elder brother was brought to him, and he made him governor over all the land. Thirty years reigned he as king of Egypt. When he had lived thirty years, then stood his brother in his stead, on the day of his burial.

"To be associated with this excellent invention, the names of the royal scribe, Kagabu, the scribe Hora, and the scribe Merimapu. Edited by the scribe Annana, the possessor of this roll. May the God Thoth keep from destruction all the words contained in this roll."

Several interesting touches of cotemporaneous life are noticeable in this story. The court, for example, is seen employing washmen, instead of washwomen; and their chief or boss was evidently responsible for the quality of their work; an arrangement common in the East, expressly described in other papyri of that age, and explanatory of the fates of the head butler and head baker in the Mosaic story of Joseph.

As another instance, may be cited the careful selection of her time by the Beauty (as in the Hebrew story of Esther and Ahasuerus) when she wished to obtain a difficult favor.

The elder brother's wife sitting braiding her hair recalls to the traveller's recollection the elaborate pendant tresses of important personages figured on the monuments of the Third Empire.

The temptation of Joseph may be a paraphrase of the tempta-

tion of Butau, redrawn from a Syrian or Arabian point of view. Here, told to a Pharaoh's son, it is the tale of a peasant's love; there, told to peasants, it is the story of the amours of a court. Both pictures may be copied after some more antique original; for love and fealty, jealousy and revenge, remorse and retribution have made themselves this universal dress of legend in all ages, and among all people, from the earliest inhabitation of the planet.

As the Hebrew story contains fragments of Arameean or Mesopotamian history, we may expect the Egyptian legend to give us correspondingly valuable hints of the earlier Egyptian history. Its author, or editor, the scribe Annana, has interwoven with it certain mystical or mythological elements. In fact, he makes use of the love story to introduce what seems to be a purposely obscured piece of priestly tradition, not only of the then recent civil and religious commotions of the country, but also of the far more ancient, and perhaps equally violent introduction of new deities into the national religious system by Pharaohs of the First Empire.

The Sun-god's daughter was made in the Cedar Mountain, that is, Mount Lebanon, and brought to Egypt by order of Pharaoh, to be his wife or chief concubine, and consequently to be one of the chief priestesses of the kingdom. This looks like a traditional statement of the fact of the introduction of sun worship from Syria into Egypt. This Sun-god of Syria is not Baal (the Assyrian "Shining Bel"), but Aten, Adonis, Adoni, Adonai, "the Lord" of the Hebrew Scriptures, represented by the solar disk, worshipped by the Hyksos Pharaohs of the XVIIth dynasty, and by that part of the Hyksos nation, afterwards, which continued to live, in a subjugated condition, in the Delta, after the other part had been driven back into Syria by the native Pharaohs of the XVIIIth and XIXth dynasties. When one of the Pharaohs, Amunhotep, of the XVIIIth dynasty (the son of a Syrian concubine of his father, as is supposed) restored for a time the worship of the Hyksos god (of his mother's family?) he repudiated the Theban Amun from his name, and assumed the the name ȝu-n-Aten, persecuting the Theban Amun worshippers, and erasing the name Amun from the monuments of the Empire, and especially from the Cartouches of his ancestors, the first and second Amunhotep. Hor-m-heb, the last Pharaoh of the XVIIth dynasty, restored many of these defaced Cartouches.* Menephta,

* See memoir on this subject, by Hincks, in the Trans. R. Irish Acad. 1844.

our scribe Annana's princely pupil, did the same for both the figure and name of Amun. He records the fact himself on one of the faces of the great obelisk at Karnac. And yet, while thus showing his attachment to the Theban and Memphite Pantheon, he followed his father's example, in various politic concessions and indulgencies to the worship of the god popular among the Hyksos of the Delta.

Recent discoveries show that different Rameside monarchs of the XIX. and XXth dynasties erected temples to the Sun-god of Syria, and set up their own statues in such temples, in order to keep the foreign element of the Delta quiet; while they conciliated the upcountry people, the Copts of Memphis, Abydos, and Thebes, by preserving the worship of Ptah, Amun, Thoth, &c., as the State religion. And no doubt this policy was pursued by the Pharaohs of subsequent dynasties, until the XXVIth, when Psammetichus, having his capital on the shore of the Delta and sympathising more therefore with Greece and Phœnicia than with Ethiopia, stamped out the last embers of southern Amun worship and Egyptian patriotism together by destroying Thebes, in fact leaving very little for the mithraic sun-worshipping Persians under Cambyses to do in that line. It was the cue for the Greek historians to hold up the ruins of the Nile-valley as proofs of the barbarism of the Persians. But we now know that Cambyses and Darius illustrated the temples of Egyptian deities precisely as did the Ramesides, and were probably influenced to do so by a similar State policy. That Carnak and Luxor and Quornah and Medinet Abu are dreadful and pitiable ruins, we are to thank the Greek mercenaries of the Lybian Psammetichus, whose army must have been composed of just such ruffians from the northern shores of the Mediterranean as now habitually rob and assassinate, and almost without interference, in the modern city of Alexandria.

There seems to have existed an eternal feud between the population of the Delta and the inhabitants of the proper Valley of the Nile extending from the Pyramids six hundred miles southward to the Cataract. Set or Sutey, if not the most ancient god of the Delta, was as old as Osiris, and always plainly opposed to that God of Egypt proper; quite as much as Aten was afterwards to Amun-Ra. Under the Second Empire (XI,XII d.) the hawk and the cock-eared jackal, Horus and Seth, represented on the banners of the Pharaohs Upper and Lower Egypt.

Nothing shows more plainly the long standing divergence of religious creeds.*

Everything about it shows that the Egyptian Dead Book, or Ritual, was not original, in the form known to us, but a manufacture of the priests of Heliopolis, or On, the Oxford of the Delta; was first employed at Memphis, near the mouth of the Valley; and was carried gradually up to Thebes, Nubia, and into Ethiopia. Lepsius shows how it grew gradually to its present size and form, by the edition of gloss upon gloss; which, like the branches of a Banyan tree, rooted themselves in the original soil, and having branches of their own, came to form all together a matted mass, of various ages, with a common character. It takes scarcely any notice of the great Theban Trinity, Amun, Mut and Khons. Tum (Atum) and Set, gods of the Delta, Demiurge and Devil, play as prominent a part in its formularies, with Osiris, Isis and Nephthys, deities of Abydos (between Memphis and Thebes). Thoth justifies the corpse; Anubis embalms it; Horus defends it on its perilous path to Amenti. Ptah, Athor and χnum are also mentioned; and even χem the phallic Amun, once. But in its most important passages, the god Ra, the sun pure and simple, assumes so leading a character that we must either conceive of an aboriginal sun-worship established at Thebes long previous to the Amun-worship; or, that sun-worship, aboriginal in the Delta on account of its Syrian population, gradually invaded and ascended the Nile Valley and got mixed up in various proportions with the other and equally ancient African worships.

On the sarcophagus of Mentu-hotep, a noble of the XIth

* The figure of Set erased by the Thebans from the Cartouche of our Meneptha's grandfather, Seti I. (Second Pharaoh of the XIXth dynasty), on the great columns of Luxor, and the crook of Osiris cut as if coming out of the erased figure's hands, is given in Plate XIV. The monarch was thus renamed Osirei I. One of the earliest traces of Osiris is found in the well known legend on the lid of the coffin of Men-Kaû Ra (Fourth King of the IV. dynasty, and builder of the Third Pyramid of Gizeh) preserved in the British Museum. "O, Osiris, King of Upper and Lower Egypt, immortal Menkaura! Child of heaven! born of Nu-t! begotten of Seb! Thy mother Nu-t stretches over thee the Abyss of heaven. She makes thee divine, annihilating thy foes, immortal Menkaura!" Chapter 64, one of the most important in the Ritual, carries a title purporting that it was discovered in the time of this Mencheres by prince Hortutef during his visit to one of the temples at Hermopolis. Herodotus relates that Mencheres was traditionally one of the most religious of kings (Récherches, p. 65). The great horizontal cartouche seen half way up the face of the column in the plate is that of Seti Meneptha. The top of the feathered cap of a colossal figure of the god Amun is seen coming out of the sand which covers up almost thirty feet of the column.

dynasty (that is a thousand years earlier than our Fairy Tale) is painted the oldest copy of the text of the Ritual yet found; older than the famous Turin Papyrus by more than two thousand years. The 17th Chapter begins the inscription, and runs thus:—(Lepsius. Ælteste Texte). "To the ever gracious Ra (the sun) Mentuhotep, Master of the Palace, reciteth this chapter of the resurrection on the day of days in Hades. May the word happen! I am Tum, a being who am one. I am Ra in his first dominion. I am the great god self-existing, the creator of his name, lord of gods, whom none of the gods can stop. I was yesterday, and will be to-morrow, *Osiris namely.* A fighting place of the gods has been prepared, as I said. *The fighting place is the West land namely.* I know the name of that great god who is there. Glory of Ra is his name. I am that great Bennu (Phœnix) honored in On. It is the accomplishment of what is. *What is that? Osiris namely. That which is, is the ever and eternal.* I am χem in his avatar. My two feathers have been set upon my head. *What is that? His two feathers are those of Horus namely, the protector of his father? His two feathers are, the two Urœi on the forehead of his father Tum.* I am in my land; I have arrived at my dwelling places. *What is that? It is the Sun Mountain of his father Tum.* I am come to my home. I appear in my land. I step into my province. I dwell with my father Tum to the end of days."

Compared with the diffuse repetitions and numerous glosses of the Turin Papyrus this short chapter wears a very archaic and original aspect. But glosses have already crept even into this ancient text. They are marked by a change of color on the coffin, and by italics in Lepsius's translation (given in English above). They show that Tum was the Adam, the first mythologic idea of Egypt. Ra the sun comes next. Osiris, Horus and χem appear only in the glosses. And this agrees with their absence from the monuments of the First Empire, another thousand years still further back.

The presence of Ra in this text is the important point.* The

* Tat-Ka-Ra, one of the last kings of the Vth dynasty, calls himself Son of the Sun: a title rare indeed at that time, but afterwards common enough. The first king of the VIth dynasty (TeTA on the Seti I tablet of Abydos) is called on the cenotaph of the priest Sabu Abeba, who was one of his subjects, SeRa-TeTA "Son of the Sun Teta," the goose and disk being placed *inside* the Cartouche as part of the king's proper name. I judge that it was done partly to distinguish him from the old TeTA, second king of the Ist dynasty, who, if he worshipped anything, certainly knew nothing about Amun Ra, or any other sun-god. The sepulchral stele of Hapa son of Seta, found at Abydos, repeats this cartouche of SeRaTeTA.

monuments of UserKaF, first Pharaoh of the Vth dynasty (next to that of the great pyramid builders) show the obelisk capped with the solar disk.* The name of the third Pharaoh of the IVth dynasty who built the second pyramid, Ra-Sha-F, commences with the solar disk, pronounced last: *Shafra.*† His immediate predecessor (on the tablet of Seti I.) was also a sun-worshipper, Tet-F-Ra. The tablet gives even one still earlier, NeferKaRa,‡ near the end of the IIId dynasty. Sun-worship was therefore established in Egypt, at least at Memphis, as early as the beginning of the IVth dynasty.

But we can go back still a little further, and this time by the help of our fairy tale. It is evident from the whole tenor of the story, that the Sun-god's daughter and the sacred bull of Egypt are placed in strong opposition, and yet curiously allied. They are introduced into Egypt in very different ways. The Pharaoh receives the sun-goddess with the highest personal honor. The common people receive the bull with a national enthusiasm. The one is a palace exotic, the other an indigenous grain. The Egyptians hold a festival because their own old Apis has reappeared. Pharaoh alone loves the Syrian Thammuz.

On the other hand there was a foreign connexion between these two opposed deities. The Sun-goddess was made for the Apis, and he loved her. She betrayed and slew him. Still he loved her. She again slew him. He made himself her child. Sun-worship in the palace suppressed the national worship for a time —then fostered it—finally married it. The story seems to be a mystical account of the revival of Egyptianism from some Syrian solar persecution, like that carried on by the fanatic ϰu-en-Aten of the XVIIIth dynasty, but at a much earlier date. Although we may also form the theory that the scribe Annana was one of those sagacious men, who in all ages know how to mould the minds destined to rule an empire, by instilling a state policy which shall compromise between opposing factions or a lofty eclecticism which can mix and neutralize the acids and bases of society. He may have married the sacred bull to the daughter of the sun to teach the young Menephta to respect all creeds

* Recherches. De Rougé, p. 79.

† Or, ϰaFRa; or, Chephen; he is the first who is known to have assumed the title of Son of the Sun. His banner name was Hor-User-Her Sa-Ra: "Horus of the mighty heart, Son of the Sun."

‡ The tablet of Saggara puts this name as the 5th in the IId dynasty; but where there is evidently a mistake, the Seti tablet must be followed. The naming of On,—the City of the Sun at the head of the Delta,—in the body of the text, shows where the sun-worshipping parts of the Ritual came from.

alike. The Asiatic conquests of his father, the greatest of all the Ramseses, had weakened, instead of strengthening his empire. The return wave ruined Egypt. She never was herself again. Memphis became oriental, as Cairo is now. Foreigners crowded the city and the plain. The indigenous and exotic religions strove with and debased each other, and the glories of the Classic Empire were but a thin laid varnish on worm-eaten wood. The Sun-god's daughter had at last killed the Sacred Bull.

But we see traces of authentic history in the story still older even than the apparent original appearance of sun-worship into Egypt in the IIId and IVth dynasties. And what has been said is only introductory to the statement of this curious fact.

Only four proper names appear in the story: Anepu and Batau, its two heroes; Hor-m-aχu (Harmachis) the Sun-god; and χnum,* his agent in creating the beauty. This last, χnum, was a form of Amun Ra, i. e. the Sun introduced into the worship of the Thebaid. Anum in the story is the representative agent of the Sun-god of Mt. Lebanon. Hor-m-aχu is the monumental name of the Great Sphinx of Gizeh. Although it is called the Sun-god by the author of the story, under the influence of the predominating Mithrism of his own age, no connection between the Sun and the Sphinx when it was first cut, has been demonstrated. The name Hor-m-aχu (spelled with a hawk, M, and the black disk between two hills) occurs in the stele found in the tomb of χufu's (Cheops') daughter, in connection with descriptions of the building of temples near it to Isis and Osiris,† but narrates its own *restoration*. It must therefore have been an old deity when Sun-worship entered Egypt.

Anepu, the elder brother, is the aboriginal African god, called by the Greeks Anubis, and universally represented, even in the most ancient sepulchral legends, as guardian of the dead, or tutelary god of the tombs, the mummy deity, the jackal being his emblem. On the later monuments, he has a jackal head and two high plumes, like Osiris. After Osiris became supreme God of Egypt, Anubis was made his son. But this was one of those innumerable modifications and combinations of the Pantheon which have reduced it to a mass of almost inextricable confusion. How could the jackal Anubis originally be the son of Osiris,

* Chap. 36 of the ritual, entitled: On stopping the tortoise, with a vignette of the Deceased turning back a tortoise, reads: "Coming against me, with closed lips! I am χnum, Lord of Shennu, messenger of the Words of the Gods to Ra, my tongue is the messenger of its Lords" (Birch). The sacred Scriptures of the far east were written or tortoise shells.

† Recherches, p. 49.

when the great enemy of Osiris (both in his own and in his other form of Horus) was Set, the Jackal Sphinx? We must look upon Anubis in Upper and Seth in Lower Egypt as the common representatives, during the early part of the First Empire, previous to the formation of the Osiris Pantheon, of the aboriginal Death Jackal God of North East Africa.

The presence of Anepu in our story as one of the chief actors, as taking away the life of his brother, then giving it back, then introducing him as the sacred bull to the worship of the nation, finally as governing the nation and becoming Pharaoh—stamps the myth with an aspect of the highest antiquity.

The great name in the story, however, is Batau, the younger brother. If we can place Batau in the First Empire, before the appearance of Solar and Osirian Worship, in the IIId or IVth dynasties, then Anubis worship, as Anepu the *elder* brother, "enough older to be his father," is carried back to an aboriginal, probably ante-Menian position.

I find then this name in the Ninth Cartouche of the Tablet of Kings uncovered in the Corridor of the Palace of Seti I. (XIX Dy.) at Abydos (100 miles below Thebes)—corresponding to the *Βοηθός*, first king of the second dynasty, of Manetho's lists. The cartouche seen in fig. *b*., is explained by the word BaTAU, (fig. *a*. with the determinative *a branch* meaning something wooden), found in Chapter 36 of the Ritual beginning:—

a

b

c

"Oh, bringer of the boat to this dreadful shore! . . . . *Anchor.* Tell me my name.

Answer. Lord of the earth in a box is thy name. *Rudder.* Tell me my name.

Answer. Trampler on Hapi is thy name. *Rope.* Tell me my name.

Answer. The hair which Anepu brings for his work of embalming the dead, is thy name," &c.

Birch translates the word Batau in this place, *holes for ropes.* De Rougé thinks it is the name of a piece of the sacred boat (all the details of which are successively named in this curious chapter of the Ritual) of the shape of the last letter in the cartouche, fig. *b*.

But how strange to encounter, in this chapter of the Ritual containing the names of our two brothers, the hair which played so fatal a part in the tragedy of our story. It is here part of the apparatus of Anepu, as the original Death God of Egypt.

On the Tablet of Kings, discovered a few years ago in one of the Saqqara tombs (20 miles south of Cairo), the third cartouche (fig. *c.*) reads Neter Bau, "God of Souls," a very remarkable title for so early a king of Egypt. By the help of a fragment of the Royal Papyrus of Turin, it appears not only probable, but almost certain, that Neter-bau was a surname of the Pharaoh Batau. The coincidence of all this with the prominence given to the younger brother's soul in our tale, cannot be accidental.

It is equally remarkable that the next cartouche No. 10 of the Tablet of Seti I, reads Ka Kau, Manetho's Κατέχωσ, who, he says, introduced bull worship into Egypt. KaKau means phonetically "bull of bulls;" but pictorially, "worshipper of bulls." The Turin Papyrus gives the ideograph for a bull; but our cartouche and the corresponding cartouche of the Saqqara tablet give three phalluses (Kau) after the letter Ka. It is therefore entirely proper to read, "the all-begetting bull."*

KaKau is in his turn followed on the tablet by Manetho's Βίνωθρις, BeN-Neter-N, in whose name the ram occurs as second letter instead of the more usual form of N. It was the ram-headed God χnum whom the Sun-god in our story employed to manufacture Batau's wife. If KaKau was the Pharaoh who introduced the worship of Apis, or Mnevis, or both, Ben-neter-n may have introduced the worship of the buck Mendes.

Thus gradually was the animal worship of the First Empire reduced to form. Senta was perhaps the first to offer the trussed goose, Skar-nefer-ka, to formulate the worship of what afterwards became the Sokari-Osiris; and so on, until Neferkara gave himself up to Sun-worship under the form of Ra, which became the favorite state religion of the Pyramid builders.

* De Rougé prefers: "the male of males," referring to the vignette of Ch. 148 of the Ritual in Lepsius. T. B. where the sacred Bull is called "the male of seven mystic cows," and "generator of males and females." Ka is too frequently used for cows, she goats, &c., to allow us to believe that it originally meant male procreation alone. Kaui, earth, is also feminine, like the Greek γεα, γη. I see no good objection against the use of this Egyptian KaKa in etymology for discovering the origin of many European words; for example, the robber Cacus in the story of Hercules; the Greek adjective κακοσ, bad; the Cock sacred to Esculap, and the type of perpetual procreating power; the English word cock vulgarly used still for the phallus; &c., &c.

A CLASSIFIED CATALOGUE OF ANTIQUITIES COLLECTED BY MR. HARRIS, AND NOW IN HIS MUSEUM IN ALEXANDRIA, EGYPT.

The Librarian communicated a Catalogue Raisonnée of the private museum of Mr. Harris, of Alexandria in Egypt, made from a numbered catalogue in MSS. sent to him by Miss Harris, with a request that some purchaser in America be found for the collection: as, owing to the very advanced age of her father, the inestimable treasures of this classical collection may at any time be scattered. Mr. Harris commenced the collection at that early day when the rarest things could be obtained, and for comparatively moderate sums of money. Accompanied by his daughter, he was accustomed to ascend the Nile every season for nearly twenty years, exploring the tombs, and collecting genuine antiquities. The papyrus which heads the list is perhaps the most perfect large papyrus ever found, and would be a splendid acquisition by any society or university in the United States. Americans are waking up to appreciate the charms of the new science of Archæology, and unwonted interest has lately been manifested in pre-historic human remains; yet there are very few travelled Americans, even those who have a taste for such things, and read much about them, who know exactly what one should expect to find in such a collection, or what it is desirable to obtain for our new museums of Archæology on this side of the Atlantic. The following classified catalogue then may possibly serve both as a specimen of what a museum of Archæology should be, and as an indication of the kind of objects obtainable by zealous students and wealthy patrons of the science.

I. PAPYRI.

Papyrus of the Annals of Ramses II. (Sesostris) XIXth dynasty, found by Mr. Harris in a tomb at Thebes and *not yet translated*. This magnificent papyrus, about 300 feet long, consists of 116 pages, illustrated by pictures of battles, prisoners captured, temples erected and mines opened, and gives statements of revenue statistics and historical events of that reign, and is accompanied by three large tableaux descriptive of the King offering to the gods of Thebes, Memphis and Heliopolis. It has been mounted

on 72 boards and is in a state of perfect preservation. (No. 502, 503 of MSS. Catalogue.)

Roll of hieratic writing. A romance translated by M. Chabas (501).

Roll of hieratic writing, very old. Translated by M. Brugsch (500.)

Papyrus, funereal, hieratic, on a board 1' 9" long (506).

Papyrus roll, hieratic, small, well preserved (488). Four others, about the time of the siege of Troy (496–499). And other fragments (504).

Papyrus, hieroglyphic, extract from the Dead Book, on a board $2\frac{1}{2}$ feet long (505).

Papyrus leaf or reed with hieratic writing (515).

Two pieces of papyri with demotic writing (486, 487). Fragments of several papyri, hieroglyphic, hieratic and demotic, (592).

Two rolls containing several books of the Iliad beautifully written. Tryphon's grammar written on the reverse. This curious papyrus was found by Mr. Harris in Tryphon's tomb at Ma'abdey (494, 495). With it, the mummied arm of the author. The papyrus was grasped by the hand (493). Also (No. 97).

Two amulet papyri neatly rolled up, tied and suspended from the ears of mummies (484, 485).

Greek papyrus; part of an oration against Demosthenes respecting the money of Harpalus; three boxes, containing 32 fragments on 11 plates (507, 508, 509). Nine plates of fragments of a Greek papyrus of Apollodorus (514). Four plates, each containing a Greek horoscope (510, 511, 512, 513).

Papyrus reeds (490, 491); stem of the reed (489); four branches of the reed and flower (492).

II. TABLETS, &c.

The Funereal tablet of *Pâsher-en-ptah* (30 inches by 25) who died in the 11th year of the reign of Cleopatra 6th, when she was associated with Cæsarion in the government B. C. 43. The figures and hieroglyphics are in beautiful preservation, and are thus explained and translated by S. Birch, Esq: "The deceased Pirot, or Pasher-en-ptah who is styled a lord (erpa) chief, royal chancellor, sole counsellor, divine father, and chief of the attendants on the altar, son of Petbast, (or Petbubastis) and Herankh, kneels on both knees, wearing a skull cap, with the mystical lock

of hair at the right side, the 'rot' alluding to his name, the 'basin,' a long garment with girdle, over which is thrown a panther skin (anem en ab) and sandals (tebui). Before him is an inscription and a table or altar of reeds, above which is inscribed 'per er khmi hept hek' or 'sepulchral meals of food and drink' and below 'oxen, geese, incense, wax and fabrics.' He is offering to seven deities standing in a row. 1. The first of these, Osiris, with his usual attributes, is styled 'Osiris lord of the Ru-sta, dwelling in the West—great God in Ru-Kat.' He tells the deceased 'I give you a good funeral.' 2. The second deity is Hapis represented with a bull's head, having an uræus on the forehead, a long dress (namms) and a collar round the neck; he wears a scaly tunic, (shenti) and holds a crook in the right, and a whip, (khekh) and symbol of life, in the left hand. He is styled 'Hapi-Osiris, who dwells in the West—King of the Gods, lord of ages, ruler of Eternity.' He says 'I have given thee all good things in Taneter.' 3. He is followed by Isis wearing the disk, horns, and throne, uniting her celestial and terrestrial characters, and holding a papyrus sceptre and symbol of life. She is called 'Isis the great mother eye of the Sun, lord of the heaven,' and announces 'I have brought thy soul to thy body.' 4. Behind her stands Nephthys, wearing the disk and horns, surmounted by her name. She holds the same sceptre, and is draped as Isis. She is entitled 'Nepthys the sister goddess, loving her brother' and announces 'I have brought delicious air to thy nostril.' 5. Horus wearing the pschent, and hawk-headed, draped as Hapis, and holding a sceptre (gam) and symbol of life, follows Nephthys. He is named 'Horus the defender of his father in Ra-Kat' and tells the deceased 'I have granted thy race to remain in thy seat.' 6. Anup or Anubis, jackall headed, follows Horus, called 'Anup over the Hill, attached to Ut, resident in the divine abode, great god, lord of the Taser.' He states 'I have given thee a sweet odor in Hades.' 7. Imouth, represented wearing a skull cap and tunic, and holding a sceptre, closes the list of Gods. He is styled 'Aimhetp son of Ptah, great in continual rewards,' and announces 'I have given thee thy blood, to be renewed, and to be well.' 8. The Gods are followed by a personification of 'the West' represented by a hawk, or eagle on a standard, with a feather, and called 'the West, the mother of the Gods' or 'giver of the Gods.' She declares 'the mummies of the West receive thee in peace; thou

joinest them in joy.' The scene itself is surmounted by the usual winged globe, and 'uræi' called in the tablet, 'The Hut, great god, lord of heaven, giver of life,' above which appears the heaven itself with stars." At the right side of the picture, going down the whole inscription, is a sceptre (gam), a personification, as it appears from the other tablet, of the "Ru-Sta." At the left side is a notched palm branch, having sixty-four notches, rising out of the Hieroglyph "Ten million festivals." The text of the tablet is in fourteen horizontal lines, and reads "Act of homage to Osiris, lord of the Western Ru-Sta, great God in Ru-Kat, to Hapi-Osiris, great god dwelling in the West, king of gods, guardian of ages, eternal ruler; to Isis the great mother Goddess, pupil of the Sun, lady of the heaven, regent of the gods; to Nephthys the sister goddess; to Horus the defender of his father in Ru-Kat; to Anup who is over the hill, attached to the embalmment, who dwells in the divine abode, lord of the Taser; to Aiemhetp the son of Ptah; to the gods and goddesses in the West, who give sepulchral meals of food and drink, oxen and geese, frankincense and wax, linen fabrics, wine, thousands of good and clean things, which heaven has given earth, and produced to the Osirian, lord chief Chancellor, sole counsellor, prophet, priest of Ptah, priest of the gods of the White Wall, prophet of Osiris, great lord of the Ru-Sta, sacred Scribe, incense bearer of the temple of Ptah, prophet of the library, and of the gate, priest of Ptah, priest of (Athor) the lady of the Sycamore, priest of Ptah who dwells in the universe, priest of Bast, living mistress of the upper and lower country, priest of Osor-Hapi in Ru-Kat, priest of Anup who is on the hill, priest of Aiemhetp (Imouthos) son of Ptah, prophet of Ba, the soul lord of Tatta, who dwells in the pool of the great house of the living, great governor of Egypt, eyes of the king, ears of the king, filling the heart of Horus (the king) in his palace, beloved of the king as he wished, greatly beloved by all in their hearts, high priest of the lord of the world, friend of the king in the temple, royal deputy at the setting up, governor of Ru-Sta, of Ru-Kat, of Taser, of Egypt, of Hapi-neb-sat, governor of the temple of Ptah, governor of the gate, superintendent of the priest of all the gods . . . going in the temples of upper and lower Egypt, elevated to the eye in a moment the . . . . beholding the great gods born of its being, binding to Nu his great urœus, the great attendant

of the Altar Pasher-en-ptah, justified, born of the good assistant priestess of Ptah, greatest of the Southern Wall, living lord of the upper and lower world—Herank justified: He says, Hail to those who approach this chamber, record ye my name with the best of the Gods, in the festivals of the West, make ye offerings to me of sweet water and frankincense; say ye, May thy body be renewed, may thy soul live, may the delicious air which emanates from Atum come to thy nostril for ever and ever, for I am the mummy of him who was found to have done good, and not to have done any evil; I am good, doing what every one loves. —The 25th year, the 21st Paophi of the King of Upper and Lower Egypt, the lord of the two countries, Ptolemaios the saviour god, the justified, was the day of his birth — Thirteen years were passed before (my) father—the King of Upper and Lower Egypt, the lord of the two countries, the father-loving, the brother-loving, the young Osiris, the son of the sun, lord of diadems, Ptolemaios the ever-living, gave me the great dignity of chief of the attendants on the altar, in his tenth year: I was placing the urœus crown on the head, at the conducting of the King on the day when he united the Upper and Lower Countries, and performed all the ceremonies in the temples and festivals; I was arranging all the secret ceremonies, I gave the homage, I offered water to (or purified) the Horus, at his divine birth in the gold house, coming and conducting(?) the king of the Ionians, who are on the banks of the Ocean at the West, the titles of his name in Ru-Kat—'The King of Upper and Lower Egypt, the ruler of the North and South, the father-loving, the brother-loving young Osiris is crowned in his palace, and living'—He passed to the temple of Isis, mistress of the region of the eye; he made very numerous offerings, proceeding to the north of the temple which belongs to Isis, on his chariot; the king himself drove; he wore on his head a crown of gold and gems; the king delighted in his heart; he made me his priest; he issued a royal ordinance throughout Egypt, saying, The chief attendant, Pasherenptah, has been made my priest, and there is given to him an annual salary of the things belonging to the temples of Upper and Lower Egypt. The monarch went to the white wall daily, passing and repassing at Maamat; he walked over the canal of the life of the North and South; he went to my temple with his chiefs, his women and royal children, and all things, seating me

in the boat with his passengers, to perform all the festivals of the gods and goddesses who belonged to Memphis, as the greatest of those he loved; the lord of the earth was delighted, wearing his crown in front of his (followers). I was a chief provided with all things; I had daughters; when I reached the age of forty-three, no male son was born to me. The image of that god Aiemhetp, the son of Ptah, gave me a male son; his name was called Aiemhetp, surnamed Pet-sa-hasi, born of the lady Ta-aiemhetp, justified, daughter of the divine father, prophet of Horus, lord of Kham, bringer of the Apis . . . . in the reign of the majesty of the ruler, the lady of the world Cleopatras, and her son Cesaes, the 11th year, the 15th of the month Epiphi was the day on which he died; he was placed in the great quarter, and there were performed all the ceremonies of mummification, and he was at rest in his sepulchre in the 30th of Thoth of the 12th year; he lived forty-nine years. Oh! all Gods and Goddesses, who are unnamed, let a child remain in my place for ever and ever! . . . . . keeping alive the name of the house . . . scribe of the sacred words, greatly praised of the queen of the two worlds, sacred scribe of Ba, lord of Tattu, who dwells in the pool of the palace, chief guardian of the shrine of the throne, prophet of Horus, Aiemhetp, son of Hapi, a person holding the same office, born of Herankh justified . . . . . by his greatly beloved father (in law) Hapi. (See pamphlet "On Two Egyptian Tablets of the Ptolemaic Period," by S. Birch, Esq., L. L. D., F. S. A. 1803.)

Marble tablet, 19" x 21" inches; female reclining on a couch, vase in hand; at her side a stool with cakes (559). Greek ex voto on marble (442).

Limestone tablet, 17" x 12"; black ink inscription, hieroglyphic; from the Serapeum at Memphis (565).

Limestone tablet, votive, 19" x 11"; inscription very distinct; priest offering lotus flower, cakes, &c., to Osiris throned, with crook and flail, double crown, asp and horus; in background, Isis with the *tau*; over all, globe and serpents; underneath, five lines of hieroglyphics (566).

Limestone tablet, votive, 11" x 8", bearing the cartouche of an unknown early king, who is adoring Mop-Hiour (deity of the tropics), surmounted by disk and winged serpents (567).

Limestone tablet, funereal, 28½" x 18"; showing a priest of

Memphis seated, incensed by his son standing in front; between them, a table and jars; underneath, 5 rows of hieroglyphics (568).

Limestone tablet for libation, 7½" x 10½", with a conduit for water; in centre, two blank cartouches and two rows of hieroglyphics (564).

Basaltic tablet for libation, 19½" x 12½", with geese, cakes, jars, figures on which the water was poured (570.)

Funeral tablet, 17½" x 11¾", with two rows of figures; in the first, a youth offering to his father; in the other, seven other members of the family; hieroglyphics below; the whole well executed (569).

Red granite slab, 3' 5" x 2 ft. wide x 10" thick; found near the Nilometer on Elephantine; bearing a square title of Osirtasin I, of the XIIth dynasty, who erected the obelisk at Heliopolis. This slab is of peculiar value, as it affords evidence of a much greater age for the Nilometer than has been assigned to it (561).

Pedestal of granite, with Greek inscription, "Leucus, protector, thrice protector, gives the present to thee, Isthaios." (301).

Black granite pillar, 3' 5" x 3' 11" in circumference; one row of hieroglyphics; cartouche of Psammetic I. 610 B. C., and the words, "Psammetic, Son of the Sun, beloved of the goddess Nepth, lady of Saïs" (558.)

Sarcophagus of Meemis, royal son of Cush, Viceroy of Ethiopia; found in a tomb at Thebes. On the island *Bighi*, opposite Philæ, Meemis is seen doing homage to Amenoph III (571).

Miniature stone sarcophagus, containing a stone mummy figure (49).

Alabaster ornament from cornice of temple (460).

Granite fragments from the temple of Medinet Abu (150, 306) —Abydos (343).

Fragments from a tomb at Thebes (155), with painting (156).

Limestone fragment covered with hieratic writing, 7¼" x 4¼" inches (145).

Porcelain fragment with hieroglyphic inscription (469).

Pottery fragment with enchorial inscription (465). Round piece of pottery taken from the breast of a mummy at Abydos, by Mr. Harris, with cartouche of Ramses II. stamped on it (602). The same from a mummy at Tell-Amarna, with a peculiar unex-

plained mark (603). The same (604). Ex voto pottery (467). Of Greek age (475).

Mummy case of a female, with nine pictures in brilliant colors; the fourth represents the four genii of Amenti; the fifth, the deceased lady Ap, priestess of Amun; the sixth, the genii of the lower regions; the seventh, the symbolical heavens; the eighth, Thoth and the eye of Osiris; in the ninth, a hand offers a *tau* to the deceased; the rest is wanting (530).

Piece of very old wood, with an oval of an unknown king (435).

Mummy case fragment from Thebes, ancient, thick, covered with hieratic (553).

Board fragment with hieratic inscription (531).

Boards with hieroglyphics, representing the passage of the soul (480, 481)—the signs of the zodiac (482), the standard of Anteopolis, two foxes (532),—Ex votos (483).

Box of wood 25 inches high, with slide, covered with hieroglyphics, surmounted by a large Osiris figure, with horns and double feather (541). Another square, painted black, 7" x 8 ", found in a tomb at Thebes, full of wheat, seeds and small Osirid figures (585). Side of another of acacia wood, with carvings of palm leaf reversed (313, 466).

Wooden ex votos, 7" x $3\frac{3}{4}$", from a mummy's neck (309). Two wood tablets, with hieratic inscription from mummies' necks (463, 464). Stone amulet from mummy's neck (468).

III. MUMMIES.

Two rolls of mummy cloth (new) with fringe and shop mark attached (476, 477).

Large hank of flax thread, tied up, used for sewing mummied cloth (583).

Mummied snakes, unopened (146), with bitumen cloth (147).

Mummied cats in gilt wood, with glass eyes, 13 inches high (525); 22 inches high (526); 12 inches (529); in bitumen cloth, 22 inches long (581); cat's head (582).

Mummied crocodiles from Ma'abdey (582) in coarse cloth, 4 ft. long (587); crocodile's egg (607).

Mummied ostrich egg (479).

Mummied Ibis (3), 18" to 20" (584).

Mummied foot deformed (591).

Mummied antelope horns, in bitumened cloth (149).

Mummied bread, two large pieces (432, 433).

Bitumen fragment from Thebes (129).

IV. FUNEREAL OBJECTS, DOMESTIC TOYS, TOOLS, &c.

Censer; a unique specimen. A female arm in wood, with hawk's head at the elbow; the hand holding an incense burner in shape of a reversed scarabœus, with six receptacles for incense. "Incense was offered to the sun under the name of Osiris three times daily, viz: resin at the rising, myrrh at the meridian, and a mixture called kuphi at setting." Plutarch on Isis and Osiris, p. 73 (1). Also, the extinguisher of a bronze Coptic incense burner (446).

Incense burner, surmounted by a cupid, having discharged his arrow. Cinque-cento (520).

Tongs, bronze (458), skewer and iron ring (459), wooden tweezers (470), ancient wooden instrument of two pieces, like a paper holder (461). Utensils of Coptic Church, four on one ring (457).

Knife, bronze, with wooden handle (425).

Nail, bronze, old (394).

Sickle, iron, with wooden handle, of the same shape with those now in use. This very remarkable object was found in an ancient tomb at Thebes (142).

Arrowhead of iron (398). Spearhead, small, bronze (596).

Engraving instruments, bronze (77, 78, 79).

Cubic measure in stone, see Lepsius and Brugsch (47); in ebony, $3\frac{1}{2}$ inches long (382): same (396).

Half-ounce weight, the ancient Egyptian 5 *Kat.* The only one yet found.

The ancient Egyptian 5 kat, or $\frac{1}{2}$ outen weight, the only one yet found, and from which has been determined the precise value in weight of the "kat" and "outen" so frequently mentioned in the hieroglyphical inscriptions; it weighs $45\frac{1}{4}$ grammes. In an article written on this weight by Mr. Chabas, he remarks, "Je dois à l'obligeance de Mr. Harris une communication qui nous permettra d'élucider ce point important (the value of the above weights) de la métrologie pharaonique—le savant antiquaire a acheté a Thebes un poids, de la forme d'un cone tronqué, posé sur sa base la plus etroite, et courronné d'une calotte spherique: la

substance est une pierre d'un gris noirâtre que M. Harris nomme "serpentine du desert" . . . . . Sur la calotte est gravée une legende dont le dessin ne permet pas le déchiffrement . . . Hereusement il ne peut exister le moindre doute sur le sens de l'inscription gravée sur la partie conique. On y lit en effet (translation) "Kat 5 du trésor d'or." Nous apprenons ainsi que nous avons affaire à un poids de 5 "kat" proveuant des magasins royaux, et peut être ménu à un étalon deposé daus ces magasins òu les pharaons entassaient leur richesses. Il ne s'agit pas içi d'un monument fabriqué pour un usage commemoratif, ou funeraire, comme la plus part des coudées qu'on a retrouvé, mais d'un poids exact, ayant réellement servi à un pésage officiel d'objet précieux. Cette circonstance augmente notablement l'intérêt qui s'attache à cette mesure antique. Mr. Chabas goes on to calculate the weight, which is established at 45¼ grammes, and then proves by means of a translation of a gold account, from Mr. Harris' large papyrus of the annals of Rameses II. that the 5 "kat" weight formed half of an "outen," thereby fixing the value of this latter weight. [See 'Note sur un Poids Egyptien, &c., par M. F. Chabas.]*

Coptic weights, copper (51), 9838 grains; (57), 774 grains; (58) 137½ grains.

Touchstones, Lydian stone, chrysites, used by the ancient goldsmiths for testing the genuineness of gold (53, 54, 55, 56), the latter much worn and covered with gold on one side, from long use.

Mouldstone with the figure of a duck (136); bronze crucible with a long handle (445).

Inkstand bearing name of Amosis, royal son (62); inkstand in hard wood, 13 inches long, bearing cartouche of Sabaces I. of XXVth dynasty, B. C. 714, and other hieroglyphics, very distinctly made (132). Wooden inkstand 11¼ inches long, with pencil, and red and black pigments, no inscription (144).

Kohl stand and pencils of the time of Amenoph II, III. (XVIIIth dynasty), B. C. 1404, 1403 (42). Kohl stand, alabaster, a long vase embraced by an ape, with pencils (327). Kohl

* In a recent discovery of the table silver of some Roman General (probably Varus) near Hildesheim, in Prussia, Dr. Bendorf of Göttingen has deciphered twenty-four inscriptions in ancient Roman characters engraved on the vases, which will go far to set at rest the vexed question of what the *Roman* weights really were.

mortar and pestle, alabaster (326). Same, black marble (330). Kohl vase, porcelaine, with three cartouches, nomen and cognomen of Amunoph III. (335). Piece of the raw mineral kohl (128).

Vases of alabaster. One $8\frac{1}{4}$ in. high, 5 in. diam. (140). Grey and white (151). One holding 76 old bronze coins (157). Small (318). Oval, with two handles, $5\frac{1}{2}$ in high (320). One with lid and cartouches of Amenoph II., B. C. 1414 (321). Same of Ramses II., B. C. 1311 (322). Cup-shaped (323). Long, narrow, two (324, 334). Long, 10 in. high, with hieroglyphic inscription (325). Small red and white)328). Small (332). Very small (333). Another (339). Another with various small antiques in glass, porcelain, &c. (478). Old marble vase (545).

Vases of vitrified pottery. Parts of two, with hieroglyphics, one of Amsit, the other of Hapi (543, 544).

Jar of pottery. Handle of wine jar (307), with fruit of Persea tree (310). Jar covered with long blue beads (311). With mummied fruits (316). Top of a jar, sealed with mud an inch thick, whitewashed, and with a hieroglyphic inscription. The figure of a horse very rarely found (539). Elongated pottery jar (547). Large earthenware jar found at Thebes, 2' 4" high (589).

Earthenware water bottle in the form of a duck.

Tear-bottle in terra cotta (427).

Jars of stone, representing the four genii of Amenti, containing the viscera of the deceased, and deposited in the tomb, viz: the monkey headed, *Hapi*, holding the smaller intestines (535). The hawk headed, *Kebhnsnof*, holding the liver and gall (536). The human headed, *Amset*, holding the stomach and larger intestines (537). The fox headed, *Smauf*, holding the lungs and heart. Repeated in Nos. 549, 551, 552.

Jar of granite surmounted by human head (546). Canopic.

Vase of pudding stone representing one of the genii of Amenti (395).

Vases of bronze, $17\frac{3}{4}$ inches high (302). Same, with figures of women offering to Isis, Athor and Osiris (444). Jar of bronze(90).

Urn of colored glass, lavender and white (246).

Jar of Glass, small, yellow (216).

Bottles of glass. Scent-bottle in shape of a column (23). Scent-bottle(?) in shape of a human head (434). Tear-bottle

5¾ in. high, opaque glass, found in Alexandria (40). Same, transparent, 5½ inches (41). Another (91).

Tear bottle in agate (92).

Wooden bottle in the form of a woman, very ancient (16).

Basket of gold with double handle (249).

Yoke of wood for carrying heavy weights from the shoulders (556).

Walking stick, 3 ft. 9 in. long, found at Thebes (555).

Guitar made of a tortoise shell with a long wooden handle, like that now used in Nubia (462).

Chessman of blue porcelain (341). A draughtsman of bone (340). A playing die of limestone (342).

Child's ball in papyrus leaf (5). Ball of blue and black porcelain (337). Chair leg of wood, one foot long (312).

Sandal, 8 inches long by 3 wide, yellow, with blue stripes at the toes (158). Another, same size, alternate blue and brown stripes down the sole (158). Three children's slippers of basket work (436, 437, 438).

Neck-pillow or head rester of acanthus wood, 4½ inches high, 7 inches across, with hieroglyphical inscription, very ancient(138). Another of sycamore wood, 5⅜ x 7⅞ inches, plain (139). Miniature head-rests (amulets) one of touchstone (385), the other of black stone (392).

Hair pin of ivory, 8½ inches, carved head (170). Two others of wood, 6 and 9 inches, slightly curved at the tops (181, 182). Another of beautifully carved wood (407).

Mirror of bronze, 7½ x 6¼ inches (443).

Toilet box, duck shaped, of wood, with slide (424).

Key of iron with two wards, 5½ inches (300). Small bronze key (406). Small wooden key (448).

V. ORNAMENTS, SEALS, AMULETS.

Necklaces. Several joined together and composed of malachite, cornelian, amethyst and glass beads, with figures of Typhon in cornelian (233). Long necklace of four rows of gold beads (251). Necklace of eleven composition white beads, studded with garnets, and ten cornelian beads (261). Necklace of round cornelian beads, with gold pendants in shape of half pomegranates, with a gold eagle (284). Necklace of round cornelian beads, interspersed with cornelian Osiris-eye, gold pendants, basket,

eagle and palm branch (285). Necklace of cornelian beads with pendant gold pomegranate flowers (286). Necklace of cornelian Osiris-eye with gold pendants of nilometer, palm branches, basket, cartouche, flying hawk and boat's prow (283). Necklace of blue beads with attached scarab wings, from mummy (449). Necklace of large blue beads with Osirid figure; from mummy (450). Same with blue scarab; from mummy (541). Small necklace of blue and cornelian beads with attached Anubis; do. (452). Long necklace of blue and white beads with attached Osirid figure; do. (453) Three similar of blue beads; do., do. (454, 455, 456). Necklace pendant in porcelain, with figures of two goats and a jar in the centre(210). A lion's head in gold(259).

Armlets of black glass; a pair (165).

Bracelet of ten scarabs in stone and hard porcelain, beautifully preserved, graduated as to size, and all with distinct hieroglyphics on the reverse (597). A similar bracelet of larger scarabs (598). A bracelet of ten valuable scarabs in antique gold setting, with well-defined inscriptions; four of lapis lazuli, one crystal, one enamel, others of hard green stone (599). Bracelet of nine large valuable scarabs set in antique gold; one, large lapis lazuli; one, cornelian; one, emerald root stone; one, bone; the rest, composition differently colored; all with very distinct impressions on the reverse (600).

Ear ring of gold jewelled with pearl, emerald and agate (239). Ear-ring, plain, massive gold, with clasp in form of dragon's head (240).

Seal rings of gold. One with onyx stone and impress of a scorpion beautifully engraved (238). Large seal with perfect Jupiter's head (241). Onyx with impress of an ant (245). Gold ring in two parts (258, 260).

Rings of silver. One with a seated Thoth holding lotus staff (253). Large ring with hieroglyphic inscription (256).

Ring of bronze (389).

Rings of iron (459). One with an indistinct inscription (252). Two iron finger rings (167, 168).

Ring of porcelain, blue (270).

Ring of cornelian, with impress of a sistrum (257). Same, with impress of three lotus buds (272).

Fibulæ. Bone ring for looping up the dress (255). Another, small (161). Same, of porcelain (163). Cornelian (266). Broad, cornelian, fibulæ (384, 391).

Brooch of silver, large, with onyx (274).

Ornament, round, mosaic, of lapis lazuli and gold (275).

Ornament(?) round, bronze, perforated in centre (162).

Ornament, small, lapis lazuli (397).

Seal-bricks. A circular piece of green glass with a seal in one corner (439). Twenty-one cone-shaped earthenware government seals with various inscriptions (580). Earthenware seal bearing the device of Pasht, deity of Bubastis, age of one of the Petoubates, XXIIId dynasty, B. C. 990–842 (3). Earthenware seal with name and surname of Apries, XXVIth dynasty, B. C. 588 (63). Another with a cartouche, crowned asp and lizard (171). Long cone-shaped brick seals, 10½", with inscriptions,used for sealing property (303,304). Square pyramid-shaped light blue porcelian seal(178). Fragment of tile with some demotic arithmetic (533). A quantity of unburnt bricks without straw, bearing ancient cartouches, found at *El-habe* (577). Others found at Thebes (578). Piece of tesselated pavement stamped with the lotus leaf (61). Same from *Benha*, the ancient *Athribis* (336)–(429). Seal of cornelian attached to a string of six amethyst beads (175).

Seals. Twenty-one perfect seals of Roman age in lapis lazuli, agate, cornelian, amethyst, ruby, opal, bloodstone and touchstone (595).

Beads (not enumerated under Necklace above). A string of turquoise, amethyst, cornelian and glass beads, with four small scarabs, 7½" (180). Large pear-shaped bead of amethyst (271). Large glass bead (399).

Bead shirt (blue beads) found on a mummy; with a collar of red, blue and white beads (590).

Amulets. Porcelain cylinder bearing the name of a royal son, the crook and the tau (179). Cylinder of black stone (291). The cartouche in lapis lazuli (268). Beehive in bright blue glass, found at *Tell-Amarna* (338). Small porcelain hand (390). Triangle in lapis lazuli (279). The square (262) in lapis lazuli (264); in stone (280); in alabaster (471, 474).

Amulet. Large, unique amulet in cornelian, set with gold, with hieroglyphic inscription, translated by M. Simonides: "All things visible, all we see, all things heavenly, originate from God, and he gives them to the best doers. Therefore man must praise Him always, if he wishes to become immortal." (601).

Scarabæi. Twenty-six large scarabæi in good preservation, with very distinct inscriptions, as follows:

(1.) *Granite.* Black, 4¼" x 3", with inscription from Dead Book (98). Black, 1⅞", good shape; ditto (117). Dark 2⅞", ditto (107). Red, 3¼", do. (108). Grey, 3"; on one wing, the human-headed bird (emblem of "soul"); on the other wing, the Benou Osiris: on the reverse, inscription from the Dead Book (111).

(2.) *Diorite, &c.* Hard brown stone, 2½", with inscription from D. B. (99). Hard green stone, 3"; do. (100). Same, 2¾"; do. (113). Black stone, 2½", some gilding remaining; do. (102). Black stone, 3", well polished; do. (109). Polished green stone, 2⅜", beautifully shaped, wings striped, no inscription (114). Hard black stone, 3⅝"; on the back the figure of a scarab between the two Osiris-eyes; on one wing Osiris holding crook and flail, double crowned; on the other, Horus with disk holding crook and flail; on the reverse a group, with Osiris as middle figure with crook and flail, Isis with tau in front, Nepht with royal staff behind (106).

(3.) *Limestone, &c.* Soft limestone, 2½", inscription from D. B. (103). Limestone, 1", with the snout of a pig; reverse, crocodile and antelope (120) Glazed limestone, 2¼", exhibits the beetle in motion; name of *Amun Ra* frequent in the inscription on its reverse (115). Green marble, 2½"; inscription from D. B. (110). Alabaster, 2⅜"; do. (104) Softstone, 2"; on each wing a cynocephalus, with crown and disk; reverse, a cartouche (118).

(4.) *Gems.* Bloodstone, 3", do. (101). Same, 2⅜"; do. (116). Emerald root, or prasius, 2", beautifully polished and very perfect; do. (122). Same, 2", highly gilt at one time, and a good deal of the gilding still left on it; do. (123). Lapis lydius or touchstone, 2¾", very highly polished; usual inscription (124). Malachite, 3"; reverse, incomplete hieroglyphic inscription (105). Light green malachite, 1", slightly worn, inscription indistinct (121).

(5). *Glass.* Blue, 3¼", plain (112). Vitrified porcelain, 2¼"; middle of back, small scarab in relief; reverse, flying scarab (119).

Scarabæi not above-mentioned: Two in stone (404); 1", (401). Greystone; reverse, cartouche between hooded snakes (294). Dark greenstone, small, female (174). Very dark greenstone, small, well polished (295). Hard greenstone, 2½", in the form of a jar, on the back of another scarab with feelers extended;

reverse, inscription from D. B. (292). Slate stone, 4" x 3¼" wide, in form of jar; on each wing, Osiris-eye; reverse, inscription from D. B. (346). Limestone (296). Limestone, green glazed; reverse, a Typhon (290). Vitrified porcelain, crawling, with striped wings (293). Black stone (276). Same (278). Same, well shaped, from Saqqara (267). Same, very perfect. from Saqqara (269). Granite, 2"; reverse, inscription from Dead Book.

Scarabæi and amulets, all small, collected on a velvet cushion, and consisting of: — (*a*) Two frogs, one hippopotamus, two scarabs, several heads, all of *cornelian*, and set in gold. (*b*) Two frogs, one scarab, one male erect figure, all of *lapis lazuli*, set in gold. (*c*) One *greenstone* scarab in a setting of deep gold. (*d*) Thirteen *greenstone* scarabs, very perfect, engraved with different cartouches and hieroglyphics. (*e*) One *amethyst* scarab. (*f*) Four softstone scarabs with distinct and curious devices. (*g*) One miniature alabaster vase. (*h*) One stone figure of a grasshopper (593).

Uræus. Figure of Thermutis, the asp, emblem of the god *Neph*, and goddess. *Rauno*, and royalty in general, especially revered at Ombos (27); in bronze 3½" long (420).

Double crown. In stone (172); same (234); same (243).

Double feather. In stone, 2" (608). Double feather and disk of Osiris in glass (277).

Osiris-eye. Porcelain (235); silver (237); porcelain (402); lapis lazuli (403). Blue porcelain, 4" wide x 3" deep; same on the reverse (347). Brown porcelain, 3¼" x 2" (348).

Nilometer. Lapis lazuli, small (201); porcelain, small (219); wood (379). Porcelain group of three figures, forming a stand; in the centre a nilometer, 5" high, between Typhonic figures (416).

Lotus flower in wood (203); same (380); same (405); same, 3" long (299). Glass cup, blue, green and white, in shape of the lotus flower (329).

Locust in porcelain (206).

Fish's head, with extended jaws, 1" long, a cornelian amulet (594). Bronze Lepidotus from Kelb-el-Bate (35). Bronze Oxyrynchus; two specimens (365, 366).

Lizard in Bronze (164). Crocodile in porcelain (230).

Ibis and snake, figured on a square silver gilt ornament (287), An ibis in bronze, 4" high (377).

Hawk in *lapis lazuli* (226); same, small (228). *Porcelain*, with crown of Upper Egypt (229); same (231). *Stone*, wearing Pshent (381). *Bronze*, 6½" high (412); small bronze, on a stand (298).

Eagle in lapis lazuli (217); small gold (282).

Ant-eater in porcelain (214).

Fox in wood (64); small bronze fox (160); same (183).

Dog's head in porcelain (447).

Cat. *Bronze*, small (9); same 3½" (356); same (371); same, small (421); same, 10½" high, very perfectly preserved (516); same 7" high (523); same (on a wooden stand), 10" high, containing mummy bones (414). *Porcelain*, small (207); same (224). *Wood*, (370); same, beautifully shaped, with the usual decorations, 6" high (419); same, with necklace painted, hawk and disk on chest, earrings, scarab on forehead, very perfect (360).

Lion's head in gold, pendant of a necklace (mentioned above).

Horse on the top of an earthenware jar (mentioned above), very rare.

Rhinoceros in cornelian, very perfect (605).

Ram in bronze, small, erect (169); ram's head in stone, small (209); ram-headed ornament in composition (281). Ram offering (see Anubis, below).

Cow lying down, in bronze (10). Porcelain cow of Athor (227). Bronze eyelid of Athor's cow (166).

Bull of Apis, in *bronze*, with usual scarab mark on its back (39); same (75); same, 4" by 6" long (517). Bull of Heliopolis in bronze, with scarab mark, &c., splendidly preserved (415). Bull of Apis in porcelain (225); same in black stone (357). Bull's horn in bronze (440). Bull's eye, from the mummy of a sacred bull (59); same (60); repeated (153, 154). Bull's eye in glass (351, 352, 441). Picture of Apis on a board (534).

Monkey. Bronze pillar, surmounted by a figure of a cynocephalus, the apeheaded god Hapi, god of Hermopolis (15). Monkey in bronze (36). Porcelain cynocephalus (211); small stone, do. (254). Cornelian do. (263). Bronze do. (410). Monkey headed canopic jars (described above).

Human headed bird, typifying the soul, in glass (247).

Phœnix in bronze (367).

Gorgon in porcelain (200).

Sphynx in bronze, small (173). Ramheaded sphynx in stone

(176). Lionheaded sphynx in porcelain (315). Human head of a sphynx in bronze, surmounted by a cross (369). Porcelain sphynx (408). Large, very perfect, limestone sphynx (575). Hinder half of a granite sphynx (577).

VI. DEITIES.

God with pyramid on his head, of bronze (423).

Goddess, with double feather, disk and globe; bronze (422)

Anubis, fox headed god, in wood (185); in colored glass (204); in blue porcelain, small (208); same, gilt (273); figure of Anubis mentioned in the tablet of the temple. Porcelain tablet representing a temple; a woman offering to Anubis (409).

Thoth, god of letters, in porcelain (220); same, small (232); in lapis lazuli (244); same, in bronze, 5" (364). Thoth on square basalt—and on silver ring—mentioned elsewhere.

Kneph, the ram headed god, in porcelain, small (212); same (223); same, in bronze, 5" high (363).

Typhon in blue *porcelain* (68); same (188); same (189); same small (199); same (202); same (236); same (428). Glass transparent (250). Stone (386). Two more in the group, already mentioned, under Nilometer.

Horus, with pshent, of *wood* (7); same (8); *porcelain* (196); *stone*, small (177); *lapis lazuli*, small (187); same (193); same (194); same (197); *bronze*, small (86); same with a box, 4½" high (93).

Horus and Isis. Mutilated *stone* statue, with hieroglyphics on the seat (319); *bronze*, small, 7½" high (373); *bronze*, 9" high, splendidly preserved (378); *bronze*, broken (411); *bronze*, 9½" high (413); bronze 7½" high (522).

Horus, child, Harpocrates, god of silence, porcelaine, small (213); bronze, 5" high, hieroglyphics round the stand, (362); bronze, 7¾" high (518).

Osiris with the crowns of Upper and Lower Egypt, *bronze*, (14); same (80); same, 13" high, with crookdan flail, double crown, and asp, the tail of which divides the crown (141); same, 7" high, holding a roll of papyrus to his breast; crowned with both crowns, surmounted by a star (374). Same, 9½" high, with crook and flail, and double crown (375). Same, 10¾" high, crook, flail, double crowns and asp (524). Osiris in *silver*, small, three specimens (18, 19, 20). Osiris in *alabaster*, small

(87). Osiris and Isis in *porcelain*, (221). Osiris in *glass* (288). Osiris in *wood*, 13" high, on stand, with double crown (550). The beard of Osiris from a statue in *wood* (137). Head of a granite statue of Osiris, 19½" high, with double crown (562). Three other figures of Osiris on tablets mentioned under that head. Tablet of limestone, 7¼ x 4¼", with figure of Osiris, crook, flail, disk, nilometer, and tau, and two rows of well executed hieroglyphics, (143).

Osirid figures, emblem of the dead. Of *stone*, 8" high (22). Same 5¼" (24). Black stone, 4", 6", 6½", (65, 66, 67, 71). *Granite* (130). Of *porcelain*, blue, 5", 5½" high, two (25, 26). Green 5½", bright blue 6¼", stone colored 7⅜", three (29, 30, 31). Same, (131). Black marble, 7½" (350). White marble, 5" (73). *Pottery*, 7⅛", 7¼", two, (72, 74). In *alabaster*, 4⅝", two, (69, 70). Small Osirid figures (81, 82, 83, 84). In *wood* 8½", 9½" 10", three (94, 95, 96). Figure mentioned above, with box, 25 inches high. Others found in a black box, mentioned above.

AmunRa in bronze, small (88). Same seated, bronze, 9" high (376).

Isis, small (184). In lapis lazuli (192). For Isis and Horus, see under Horus, Nos. 221, 373, 278, 411, 413, 522.

Isis and Nephthys with Horus between them, in porcelain (242).

Nephthys alone, porcelain (198).

Isis and Anubis. Tablet representing a temple, 3½" x 3"; ram headed Isis offers sistrum to Anubis; reverse, nilometer between two taus (349).

Isis and Osiris. Tablet of sycamore wood representing a temple, Isis offering to Osiris (388).

Athor. Small porcelain column surmounted by two heads of Isis in form of Athor (28). Mirror and staff, head of Athor, in bronze, 9" high x 4" broad (134). Porcelain figure of Athor (186).

Pasht, catheaded goddess of Bubastis. Bronze (6). Pasht erect in porcelain (11, 13). Same seated (12). Lion headed Pasht (85). Pasht, seated, small (191). Porcelain Pasht (222). Same (355). Pasht, seated, lapis lazuli (265).

Tmei, goddess of truth and justice, daughter of the sun, whose image was worn round the neck of the judge in court, with which he touched the gainer of the suit in token that the right was on

his side. Lapis lazuli, small, (4)—(190). Blue porcelain figure of Thmei as one of the four genii of Amenti already mentioned.

Goddess with double feather, disk and globe, mentioned above under double feather.

Goddess with Hippopotamus head, worshipped at Papremis, (Herod.) porcelain (358). Another has been mentioned under collection of scarabs on a velvet cushion.

Tpe, mother of Osiris, kneeling, and holding up the heavens (195).

VII. HUMAN FIGURES.

Priest holding crook and tav, 5¾" high, *bronze* (37). Same, 6" (417). Same, 6" (519). Same without the tav, 5¾" (38). Same, 5" (418). Same, 4¾ (353). Priest kneeling, crown of Upper Egypt, bronze (368).

Judge seated, in *stone*, with faint hieroglyphic inscription round the chair, very perfect (31). Judge seated holding a scroll on his knees, *bronze* (361). Repeated, 5¼" high (521).

Amunoph III. (XVIII. dynasty, B. C. 1403—1367) in wood, 11 inches high (45).

Man seated, in blue porcelain (400).

Man running, small, bronze (383).

Negro crouching, pottery (17).

Nubian erect, wearing the kilt, wood, 10" high 354).

Female holding a child, seated, porcelain (393).

Female (headless) arms extended aloft, wood, 6" high (359).

Female bust, Roman, terra cotta, (51). Female head, do. do (344).

Female head belonging to a granite statue, 10" high x 17" wide (557).

Head of a jester, terra cotta (52).

Heads from tops of vases, beautifully shaped, alabaster, (527, 528). Granite bust, head wanting (540). Marble head of a cherub (542). Small granite head of a king, (548). Head of the statue of an old man evidently a portrait, from Memphis (563).

Nectanebo. Slab of basalt found at Alexandria, ? the screen or division of a temple, showing the figure of this king offering incense to his god (576).

Aten-Re-Bahu. Block of basalt 35" x 20" x 11", encircled

with hieroglyphics; on one side the Cartouche of this King, and the defaced cartouches of the foreign kings of Tell Amarna, Gebel Iana and Alabastron. See Wilkinson, p. 294 (578).

Ptolema daughter of a Ptolemy, her bust (579).

Cleopatra. Marble head of a female statue, supposed to be this queen (572).

Dacian king. A marble statue of a dacian king, kneeling, with arms tied behind his back, once forming part of a group, representing Trajan with his vanquished enemies at his feet. See Wilkinson, p. 94, (573).

Persinius Niger, an Ethiopian general, his statue in black basalt (574).

Full length figure of a man dancing with extended arms, Greek bronze (32).

Full length female figure, Greek bronze (33).

Woman, Roman bronze (89).

Man's head, Roman marble (317).

Hand, beautifully cut, Greek marble (331).

Full length female figure, holding her vail over her mouth, and supporting her dress with the other hand, Greek terra cotta, 8½" high (345).

VIII. MISCELLANEOUS, OF LATER DATE.

Large lamp, Greek bronze (2).

Incense vase, Roman bronze (44).

Column, with two female heads, with an olive wreath, Roman bronze, 4¼" (76).

Lamps, small, Roman terra cotta (133, 305, 308, 423).

Salver with movable handle, Roman bronze (135).

Wine jar top, with Greek inscription (148).

Medal of bronze (248).

Four cherubims in ivory, 3½" to 4" long, wrapped in mummy cloth, early Christian (125). Ivory lion seizing a crocodile, small, in mummy cloth, Coptic (126). Small carved ivory lion's head (127).

Piece of mummy cloth with Greek inscription, "Milupos, son of Liloanus; nobody is immortal in this world" (315).

Seal, coptic glass; black stone seal with impress of St. George and the dragon (596).

Amulet of alabaster, circular, 4" circumference, cufic inscription.

Mosaic. Several pieces of gold mosaic from Benha (Athribis).

Antique ring with two amethysts (596).

Piece of lapis lazuli (606).

Piece of tesselated pavement with lotus leaf (61).

The Annual Report of the Finance Committee was read. On motion of Mr. Fraley the following appropriations were made for the ensuing year:

Salary of Librarian, - - - - -	$700
Salary to Assistant Librarian, - - - -	360
Salary of Janitor, - - - - -	100
Petty expenses of Librarian, - - -	50
Binding Books. - - - - -	150
Hall account, - - - - - -	200
Insurance account, - - - - -	170
Subscriptions to Journals, - - - -	50
Publications in addition to the interest of the Publication Fund, - - -	1500
General expenses other than the above and including the commissions payable to the Treasurer, - - - - - -	720
	4000

And the Society was adjourned.

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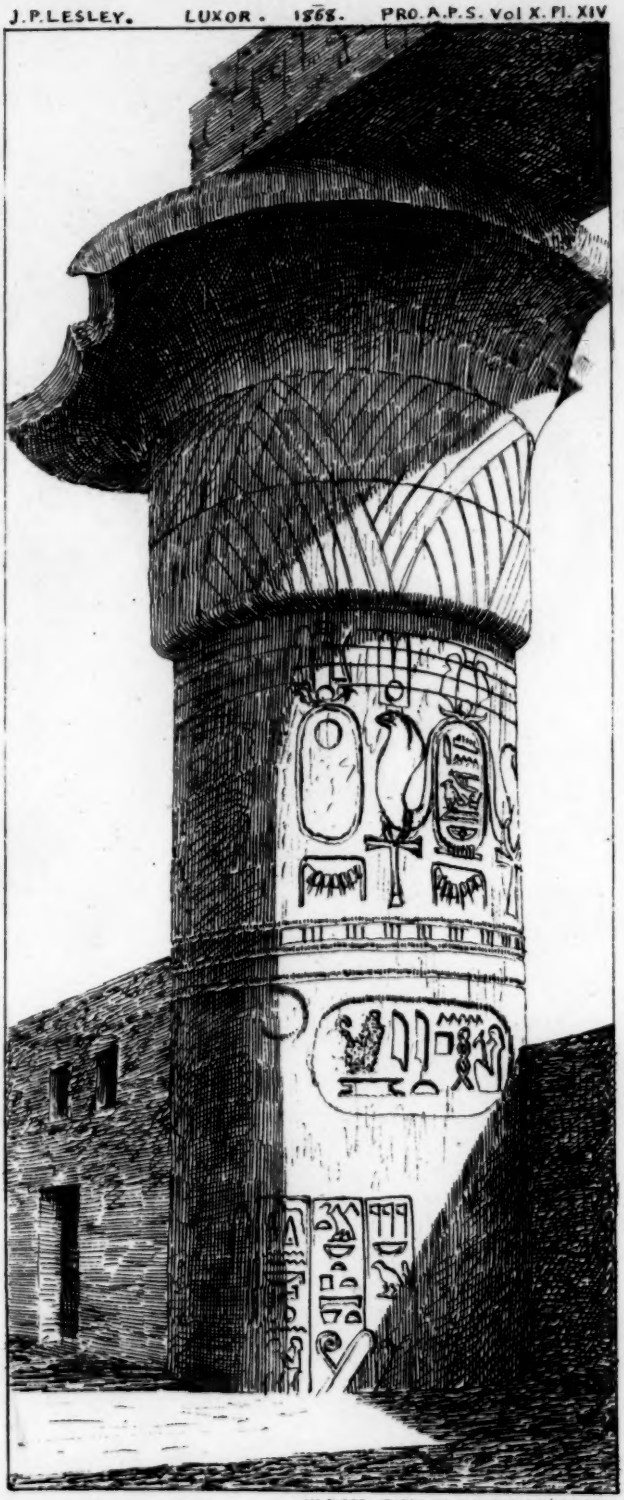

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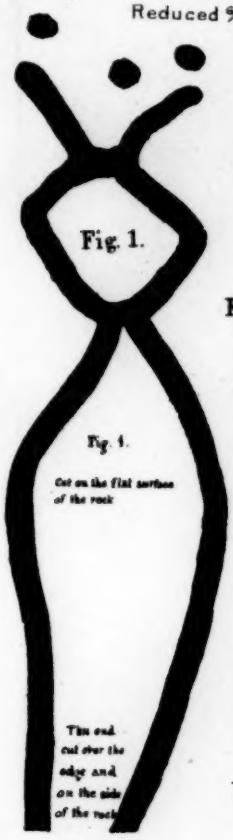

Fig. 2. From a small rock, west side of Island, below the large figures. Each face slopes south 45°±

INDIAN CHARACTERS ON ROCKS IN THE SUSQUEHANNAH RIVER. PA

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